JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
FEDERATIVE REPUBLIC OF BRAZIL

THE STUDY FOR THE DEVELOPMENT OF AN INTEGRATED SOLUTION RELATED TO INDUSTRIAL WASTE MANAGEMENT IN THE INDUSTRIAL POLE OF MANAUS

FINAL REPORT

MAIN REPORT

August 2010

KOKUSAI KOGYO CO., LTD.
EX CORPORATION

SUFRAMA Ministério do Desenvolvimento, Indústria e Comércio Exterior GOVERNO FEDERAL FIEAM JICA CIEAM CENTRO DA INDÚSTRIA DO ESTADO DO AMAZONAS IPAAM ABC KAIGISHO

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List of Volumes

Volume I	**Summary**
Volume II	**Main Report**
Volume III	**Supporting Report**
Volume IV	**Data Book**

This is the Main Report.

The exchange rate used in this report is as follows.
US$ 1.0 ＝ 89.25 Yen, 1 BRL ＝ 48.784 Yen
(March 2010)

A network of igarapé runs through the region and in Manaus. Here, illegal housing is built above igarapé 40.

There are a number of illegal settlements located in Manaus, including in the Industrial District.

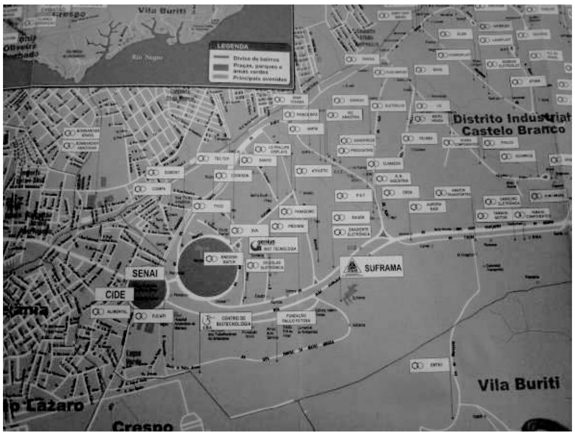
The watershed of Igarapé 40 includes much of Industrial District I. (Igarapé means tributaries of the Amazon River, narrow streams and canals)

Street vendors sell various items to passersby in downtown Manaus.

The busy port in Manaus, where tourist boats depart frequently, has a food court and market nearby.

Tourist activities also make up a large portion of Manaus' appeal as people come to explore the riches of the Amazon forest.

Plate 1:Natural and Social Conditions



SUFRAMA administrates the tax incentives for hundreds of companies, most of which are located in the two Industrial Districts, as shown here.

The SUFRAMA facility complex

Database equipment at the Industries Federation of Amazonas State (FIEAM) office in Manaus

A water treatment facility at a PIM factory. There is no wastewater treatment facility in Manaus, so factories must treat industrial effluent as well as domestic (non-industrial) wastewater themselves.

Erosion in the area is a major concern.

Billboards like this one, promoting the PROSAMIM igarapé program, are a common sight in Manaus.

Plate 2: State of Environmental Management

Illegal dumping can be found in forested areas where it is difficult to monitor conditions.

A view of the landfill in the city of Manaus

Illegal dumping of plastic containers with the Portuguese "*atenção cuidado*", indicating that *special care* is needed when handling them.

A collection truck on its way to the Manaus municipal landfill stops at the weigh bridge.

View of a private landfill

The rotary sieving machine for composting located at the Manaus municipal landfill.

Plate 3: State of Waste Management

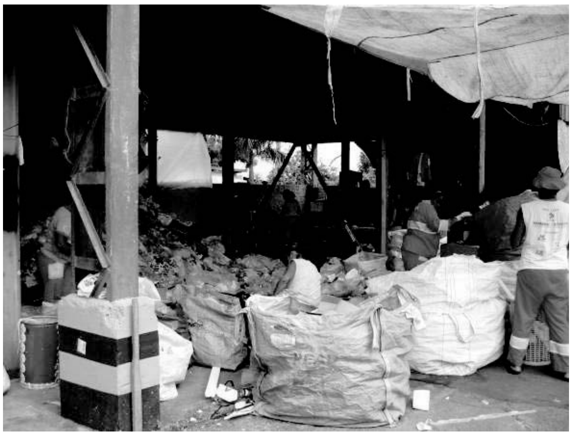
A scrap metal recycler in Manaus compacts material for processing.

The scrap metal factory sorts materials for recycling.

The paper factory in Manaus produces a large amount of cardboard.

Workers process bundles of cardboard at the paper factory.

A cement factory in Manaus.



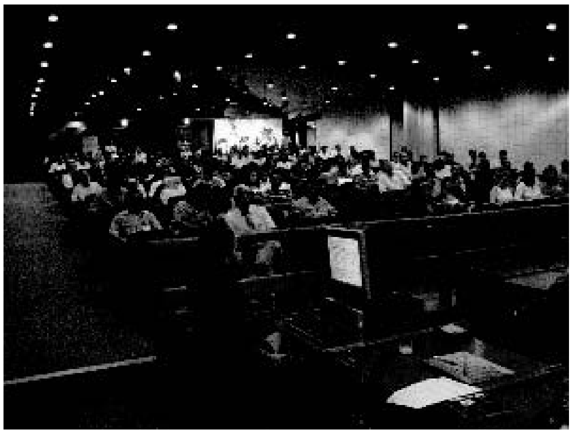
Materials are prepared for recycling at the SEMULSP recycling facility.

Plate 4: Supplement Studies on Current Conditions

JICA Team Leader, Susumu Shimura, and Deputy Superintendent of Projects, Oldemar Ianck, at the signing ceremony after reviewing the study Inception Report.

The kick-off meeting was attended by an extensive number of staff from SUFRAMA and other organizations involved in the study.

Regular weekly meetings at SUFRAMA are consistently attended by twenty or more stakeholders from various offices.



The first Workshop was held on September 11th, 2009 in the large SUFRAMA auditorium.

The study team and the SUFRAMA planning group discuss the schedule for workshops and the seminar that will be held.

IPAAM, the state environmental agency, is also actively involved in the study as a main counterpart.

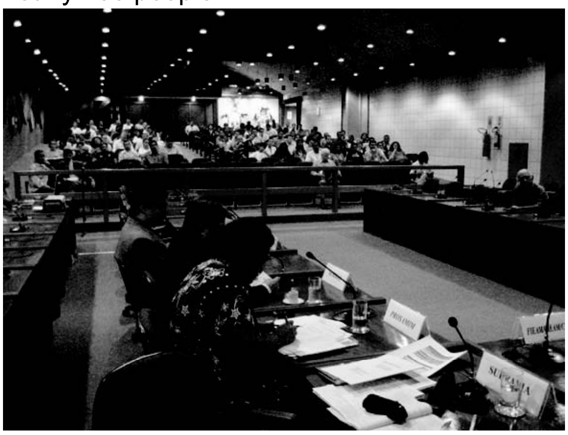
Plate 5: Capacity Development

Nearly 200 people attended the 1st Workshop on September 11th, 2009 in the large SUFRAMA auditorium.

Participants of the 1st Workshop divided into three smaller groups (about 25 people each) to discuss relevant issues

The 2nd Workshop was held on November 27th, 2009 at the Comfort Inn as part of the International Fair (FIAM 2009) and attended by nearly 150 people.

Participants of the 2nd Workshop divided into two smaller discussion groups, of about 20 people each, at the end of the afternoon.



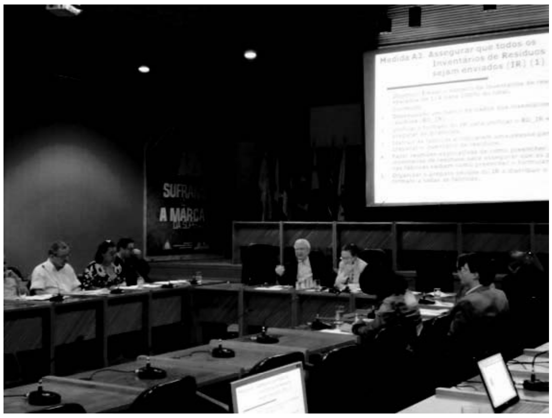
The 3rd Workshop was a full-day event held on April 6, 2010 at the SUFRAMA Auditorium and attended by nearly 150 people.

The 3rd Workshop offered afternoon small group discussions on the issues of on-site, off-site and administration of industrial waste management.

Plate 6: Workshops

A half-day seminar was held on the morning of April 7, 2010 on how to complete the waste inventory using the proposed database.

In the afternoon of April 7, 2010, IPAAM instructed waste service companies on the proposed licensing system using separate codes for municipal and industrial services.



The seminar to announce the study results was hosted by SUFRAMA on May 27, 2010. It was attended by 112 participants and featured a lively question-and-answer session.

Speakers at the seminar presented the proposed M/P based on previous

Television and newspaper media also attended the seminar on May 27, 2010 to publicize the study results and conduct interviews.

Representatives from SUFRAMA and IPAAM in Amazonas went to Brasilia to explain plans to use databases for IWM to representatives from federal organizations and discussed extending the results elsewhere in Brazil.

Plate 7: Seminars

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List of Abbreviations

Abbreviation	English	Portuguese
ABC	Brazilian Cooperation Agency	Agência Brasileira de Cooperação
ABNT	Brazilian Association for Technical Specs	Associação Brasileira de Normas Técnicas
ANA	National Water Agency	Agência Nacional de Aguas
ANEEL	Brazilian Electricity Regulatory Agency	Agência Nacional de Energia Elétrica
ANVISA	National Health Surveillance Agency	Agência Nacional de Vigilância Sanitária
ARSAM	Amazonas Regulatory Agency of Public Services	Agência Reguladora dos Serviços Públicos Concedidos do Estado do Amazonas
ATRINI	Non-hazardous & non-inert industrial waste temporary disposal site	Aterro Temporário de Resíduos Industriais Não-Inertes
CAPDA	Committee for Research and Development Activities in Amazonas	Comité das Atividades de Pesquisa e Desenvolvimento na Amazonia
CAS	Administration Council of SUFRAMA	Conseho Administração da SUFRAMA
CCINB-AM	Japanese-Brazilian Chamber of Commerce and Industry of Amazonas	Câmara de Comércio e Indústria Nipo-Brasileira do Amazonas
CD	Capacity Development	Desenvolvimento de Capacidade
CIEAM	Industries Center of Amazonas State	Centro da Industria do Estado do Amazonas
CNEN	National Commission of Nuclear Energy	Comissão Nacional de Energia Nuclear
CNI	National Confederation of Industies	Confederação Nacional da Indústria
COGEC	General Coordinator of Economic and Business Studies	Coordenação Geral de Estudos Economicos e Empresariais
CONAMA	National Council for Environment	Conselho Nacional de Meio Ambiente
COSAMA	Amazonas Sanitation Company	Companhia de Saneamento do Amazonas
C/P	Counterpart	Contraparte
DF/R	Draft Final Report	Minuta do Relatório Final
DG/L	Draft Guidelines	Esboço das Diretrizes
DI	Industrial District	Distrito Industrial
EIA	Environmental Impact Assessment	Avaliação de Impacto Ambiental
ERENOR	Representative Office of the Ministry of External Relations in the Northern Region	Escritório de Representação do Ministério das Relações Exteriores na Região Norte
FIEAM	Industries Federation of Amazonas State	Federação das Indústrias do Estado do Amazonas
F/R	Final Report	Relatório Final
FUCAPI	The Technological Analysis, Research, Innovation Center Foundation	Fundacão do Centro de Analise, Pesquisa e Inovacão
GEA	Government of Amazonas State	Governo do Estado do Amazonas
GIS	Geographical Information System	Sistema de Informação Geográfica
GOB	Federative Republic of Brazil	República Federativa do Brasil
GOJ	Government of Japan	Governo do Japão

IBAMA	Brazilian Institute for the environment and Renewable Natural Resources	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
IBGE	Brazilian Institute of Geography and Statistics	Instituto Brasileiro de Geografia e Estatística
IBRD	International Bank for Reconstruction and Development	Banco Internacional para Reconstrução e Desenvolvimento (BIRD)
IC/R	Inception Report	Relatório Introdutório
IDB	Inter-American Development Bank	Banco Interamericano de Desenvolvimento (BID)
IEE	Initial Environmental Evaluation	Avaliação Ambiental Inicial
INMET	National Institute of Meteorology	Instituto Nacional de Meteorologia
INPA	National Amazon Research Institute	Instituto Nacional de Pesquisas da Amazônia
INPAE	National Institute for Environmental Preservation	Instituto Nacional de Preservação Ambiental
IPAAM	Institute of Amazonas Environmental Protection	Instituto de Proteção Ambiental do Amazonas
IT/R	Interim Report	Relatório Intermediário
JICA	Japan International Cooperation Agency	Agência de Cooperação Internacional do Japão
MCIDADES	Ministry of the Cities	Ministério das Cidades
MDIC	Ministry of Development, Industry and Foreign Trade	Ministério do Desenvolvimento, Industria e Comercio Exterior
MFZ	Manaus Free Zone	Zona Franca de Manaus
M/M	Minutes of Meeting	Minutas da Reunião
MMA	Ministry of Environment	Ministério do Meio Ambiente
MME	Ministry of Mine and Energy	Ministério de Minas e Energia
M/P	Master Plan	Plano Diretor
MS	Ministry of Health	Ministério de Saúde
NBR	Technical Rules	Normas Brasiliras
NGO	Non-Governmental Organization	Organização Não Governamental
OJT	On the Job Training	Treinamento em Trabalho
PIM	Industrial Pole of Manaus	Polo Industrial de Manaus
PMSS	Program for the Modernization of Sanitation Sector	Programa da Modernizacao do Setor de Saneamento
PROSAMIM	Socio- Environmental Program of Manaus Igarapes River Bank	Programa Social e Ambiental dos Igarapes de Manaus
RDC	CONAMA Resolution	Resolução do CONAMA
SEA	Strategic Environmental Assessment	Avaliação Ambiental Estratégica
SEDEMA	Municipal Secretariat of Development and Environment	Secretaria Municipal de Desenvolvimento e Meio Ambiente
SEINF	State Secretariat of Infrastructure	Secretaria de Estado de Infra-Estrutura
SEMMA	Municipal Secretariat of the Environment	Secretaria Municipal de Meio Ambiente
SEMULSP	Municipal Secretariat of Urban Cleaning and Public Services	Secretaria Municipal de Limpeza e Serviços Públicos
St/C	Steering Committee	Comité de Direcção
SUFRAMA	Superintendency of the Manaus Free Trade Zone	Superintendência da Zona Franca de Manaus
SUDAM	Superintendency for the Development of Amazon Region	Superintencia do Desenvolvimento da Amazonia
S/W	Scope of Works	Escopo de Trabalho
TOR	Terms of Reference	Termos de Referência

TCSC	Technical Consultive Sub Committee	Subcomitê Consultivo Técnico
UGPI	Unit of Management of the Igarapes Program	Programa Social e Ambiental dos Igarapés
WB	The World Bank	Banco Mundial
WI_DB	Waste Inventory Database	Banco de Dados dos Inventários de Resíduos
WM	waste manifest	manifesto de resíduos
WSC_DB	Waste Service Company Database	Banco de Dados das Empresas de Serviço de Resíduos
W/S	Workshop	Workshop

Classification of Industries (Factories) and Industrial Wastes used in the Study

The following is the classification of the target industries (in the study, only factories) and industrial waste categorization used in the study, which served as the premise to conduct the study to improve industrial waste management.

1. Classification of Industries (SUFRAMA's factories)
2. Industrial Waste Categories
   - 2-1 General Industrial Waste
   - 2-1(a) Non-hazardous General Industrial Waste Categories used in the study
   - 2-1(b) Comparison of Study Code and CONAMA Code for Non-Hazardous General Industrial Wastes
   - 2-1(c) Hazardous General Industrial Waste Categories used in the Study
   - 2-1(d) Comparison of Study Code and CONAMA Code for Hazardous General Industrial Waste
   - 2-2 Health-care Waste
   - 2-3 Construction Waste
   - 2-4 Radioactive Waste

1. Classification of Industries (SUFRAMA's Factories)

Factory Code	Sector		
	Main Category		Sub-category
F01	Beverages		
F02	Leather		
F03	Printing		
F04	Electrical		
		4-1	Parts
		4-2	Products (except copy machines)
		4-3	Copy machines
F05	Lumber		
F06	Machinery		
		6-1	Clock/watch
		6-2	Other machinery industry
F07	Metal		
F08	Nonferrous		
F09	Furniture		
F10	Paper		
F11	Rubber		
F12	Food		
F13	Chemical		
F14	Plastic		
F15	Textiles		
F16	Clothing		
F17	Transportation		
		17-1	Two-wheelers
		17-2	Ships
		17-3	Other transportation
F18	Construction		
F19	Other		
		19-1	Optics
		19-2	Toys
		19-3	Small instruments
		19-4	Writing utensils, razor blades
		19-5	Other

Source: CGPRI & CGMER/COCAD SUFRAMA, up to 8/2008 "Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA "

2. Industrial Waste Categories

The study targeted industrial waste that factories must report upon making a waste inventory as required by CONAMA Resolution 313. Those wastes can be classified into 4 main categories, as shown below. Due to differences in the generation source and characteristics of each of these wastes, they were each surveyed individually in this study.

- General Industrial Waste: waste generated from factories other than 2, 3, and 4 below.
- Health-Care Waste: waste generated from medical facilities attached to factories.
- Construction Waste: waste generated from renovation and expansion construction at factories
- Radioactive Waste: waste generated from radioactive material used by the factory.

2-1 General Industrial Waste

In this Study, the general industrial waste generated from 187 factories of PIM was surveyed. Given the limited period of time for the study, a survey to gain an understanding of the overall management of general industrial waste in PIM was carried out using a simplified version of the complex industrial waste categories required by CONAMA Resolution 313. Namely, the study looked at 13 types of non-hazardous general industrial waste, and 16 types of hazardous industrial waste, and then clarified the management of each in terms of waste generation management (by creating “waste stream” diagrams and such). However, a user manual was put together for completing the waste inventory, which the factories are legally required to submit, according to the categories required by CONAMA Resolution 313. Tables comparing the JICA Study Team Code and the CONAMA Code are provided in order to clarify the factory survey results from the study and to facilitate cross-checks of the results of waste inventories made according to the manual after they are compiled and analyzed.

2-1(a). Non-Hazardous General Industrial Waste Categories used in the Study

Type of Non-Hazardous, Non-Inert Industrial Waste (Non-HGIW)	Non-HGIW Code
Kitchen waste (include waste from animal such as bone, skin, hair)	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Animal oil, Vegetable oil	NH06
Rubber and Leather	NH07
Ash/dust from coal-fired power plants, etc.	NH08
Metals and metal alloys such as aluminum, copper, bronze	NH09
Ceramic & Glasses	NH10
Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH11
Mixed waste (This code shall be applied in case wastes are discharged without separation.)	NH12
Others	NH13

Source: JICA Study Team

2-1(b). Comparison of Study Code and CONAMA Code for Non-Hazardous General Industrial Waste

Study Code	CONAMA Code	Description of Non-HGIW
NH01	A001	Residues of restaurant (food remaining portions)
	A024	Bagasse of sugar cane
	A499	Carnaça
	A599	Residues organic of process (tallow, serum, bones, blood, others of the nourishing industry, etc)
	A699	Rind of rice
	A999	Residues of fruits (bagasse, must, rind, etc.)
NH02	A009	Residues wooden I contend not toxic substances
NH03	A006	Residues of paper and cardboard
NH04	A007	Polymerized plastic residues of process
	A107	Bombonas of plastic not contaminated
	A108	Etil acetate residues vinila (EVA)
	A207	Plastic films and small packings
	A208	Polyurethane residues (PU)
NH05	A010	Residues of têxteis materials
NH06	---*1	---
NH07	A008	Rubber residues
	A299	Caleadas shavings of skins
	A399	Atanado leather shavings, remnants
NH08	A111	Leached ashes of boiler
NH09	A004	Ferrous metal scrap iron
	A005	Not ferrous metal scrap iron (brass, etc.)
	A011	Not metallic mineral residues
	A012	Slag of aluminum casting
	A013	Slag of iron production and steel
	A014	Slag of brass casting
	A015	Slag of zinc casting
	A016	Sand of casting
	A104	Metallic packings (empty cans)
	A105	Not ferrous metal packings (empty cans)
	A204	Tambores metallic
NH10	A017	Refractory ceramic residues and material
	A025	Fibre glass
	A117	Glass residues
	A799	Atanado leather Serragem, bran and dust
NH11	---*1	---
NH12	A002	Generated residues outside of the industrial process (office, packings, etc.)
NH13	A003	Residues of varrição of plant
	A018	Solid residues not toxic metal composites
	A019	Solid residues of stations of treatment of effluent I contend material biological not toxic
	A021	Solid residues of stations of treatment of effluent I contend not toxic substances
	A022	Pastosos residues of stations of treatment of effluent I contend not toxic substances
	A023	Pastosos residues I contend limy
	A026	Slag of jateamento I contend not toxic substances
	A027	Used catalysers I contend not toxic substances
	A028	Residues of system of control of not toxic gaseous emission I contend substance (sleeve precipitadores, filters, among others) Products are of the specification or are of the validity stated period contend not dangerous substances
	A029	Other not dangerous residues
	A099	Salty shavings
	A199	Foam
	A308	Silt of the caleiro
	A899	Generated residues outside of the industrial process (office, packings, etc.)

Source: JICA Study Team

*1 : There is no Study code where the corresponding CONAMA code is indicated.

2-1(c): Hazardous General Industrial Waste Categories used in the Study

Type of Hazardous General Industrial Waste (HGIW)	HGIW Code	Example of Hazardous General Industrial Waste (HGIW)
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic Compounds	HW04	including Hg, As, Cd, Pb, Cr, CN
Inorganic Compounds	HW05	Plating wastes, Picking waste, Sulphides, etc.
Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.
Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge	HW11	Inorganic sludge, Organic sludge, Septic tank sludge, etc.
Ash from incinerator	HW12	---
Dust and Air pollution control (APC) products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above
Mixed Waste	HW15	---
Hazardous materials from Non-production process	HW16	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.

Source: JICA Study Team

2-1(d): Comparison of Study Code and CONAMA Code for Hazardous General Industrial Waste

Study code	CONAMA code	Description of Hazardous General Industrial Waste (HGIW)
HW14	C001 to C009	Listing 10 - dangerous residues for containing volatile components, of which do not apply solubility and/or leaching tests, presenting superior concentrations to the indicated ones in listing 10 of Norm NBR 10004
HW10 HW08 HW09 HW14	D001	Dangerous residues for presenting inflammability
HW01 HW02 HW03	D002	Dangerous residues for presenting corrosively
HW01 HW02 HW03 HW07	D003	Dangerous residues for presenting reactivity
HW10 HW14	D004	Dangerous residues for presenting pathogenicity
HW05 HW06 HW10 HW11	D005 to D029	Listing 7 of Norm NBR 10004: dangerous residues characterized by the leaching test
HW04	K193	Shavings of leather tanned with chromium
HW04	K194	Leather Serragem and dust containing chromium
HW04	K195	Silt of effluent treatment stations for chromium tanning
HW14	F102	Residue of catalysers not specified in Norm NBR 10.004
HW04 HW10	F103	Deriving residue of industrial laboratories (chemical products) not specified in Norm NBR 10.004
HW14	F104	Not specified contaminated empty packings in Norm NBR 10.004
HW07	F105	Solvent contaminated (to specify solvent and the main contaminant)
HW14	D099	Other dangerous residues - to specify
HW04 HW07	F001 F0301	Listing 1 of Norm NBR 10004- admittedly dangerous residues - Classroom 1, of not-specific sources
HW07	F100	Bifenilas Policloradas - PCB`s. Packings contaminated with PCBs also transforming and capacitors
HW07	P001 to P123	Listing 5 of Norm NBR 10004 - dangerous residues for containing toxic substances acutely (remaining portions of packings contaminated with substances of listing 5; contaminated residues of spilling or ground, and products are of specification or products of commercialization forbidden of any constant substance in listing 5 of Norm NBR 10.004
HW04 HW07	K001 to K209	Listing 2 of Norm NBR 10004- admittedly dangerous residues of specific sources
HW07	K053	Remaining portions and spots of inks and pigments
HW07	K078	Residue of cleanness with solvent in the manufacture of inks
HW07 HW11	K081	Silt of ETE of the production of inks
HW10	K203	Residues of illness research laboratories
HW01 HW09	K207	Residue the used oil re-refining (containing acid)
HW14	U001 to U246	Listing 6 of Norm NBR 10004- dangerous residues for containing toxic substances (contaminated residues of spilling or ground; products are of specification or products of commercialization forbidden of any constant substance in listing 6 of Norm NBR 10.004

Source: JICA Study Team

2-2: Health-care Waste

Health-care waste categorization is regulated by the Brazilian Association for Technical Specifications (ABNT) according to ABNT NBR 12808. Moreover, Handling of health-care waste is done according to RDC 306/2004-ANVISA and CONAMA Resolution 358/2005.

In this study, a medical institutions survey was conducted using a questionnaire based on ABNT NBR 12808. After the survey, it was revealed that at present, RDC 306/2004-AVNISA is being used, so the results of the survey were converted accordingly. The following table shows conversion of health-care waste categories of the RDC 306/2004-ANVISA and ABNT NBR 12808.

Conversion of Health-care Waste Categories between RDC 306/2004-ANVISA and ABNT NBR 12808

RDC 306/2004-ANVISA			**ABNT NBR 12808**	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

2-3: Construction Waste

Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A:	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton, metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. *(new text given by Resolution n. 348/04)*.

2-4: Radioactive Waste

Categorization of Radioactive Waste

Class	Type	Level
1. Waste containing beta or gamma emitters	1.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.3 Gaseous Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
2. Waste containing alpha emitters	2.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	2.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste

Source: Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05 – December 1985

The generation of the radioactive waste is not informed by the user of radioactive materials in the study area.

1. Outline of the Study

1 Outline of the Study

1.1 Background and Objectives of the Study

1.1.1 Background of the Study

The aim of the Manaus Free Zone (MFZ), an economic development model put forth by the Brazilian government, is not to exploit the valuable natural resources of the Amazon which are recognized the world over, but to realize sustainability of the western Amazon. The primary infrastructure of the MFZ is the Industrial Pole of Manaus (PIM[1]), which is one of the most preeminent industrial parks in Latin America. Presently, there are roughly as many as 550 domestic and multinational factories, mainly assembly production, operating in the PIM, indirectly responsible for creating 500,000 jobs and directly employing 100,000 people. In order to further promote the sustainable development of the western Amazon, the Ministry of Development, Industry and Foreign Trade (MDIC) hopes to entice production of raw materials, increase its added value as an industrial complex and promote the overseas export of its products.

PIM factories are required to submit waste inventories based on CONAMA Resolution 313; however, despite the clear interest in environmental conservation and industrial waste management, the PIM as a whole displays a lack of knowledge in these areas, and although foreign-capital and large corporations have been sure to comply, the number of inventories received is largely insufficient.

Also, due to delays in the administration's construction of a database and conducting analysis, the inventories that have been received do not clarify the amount or composition of the wastes disposed of from PIM or basic waste management conditions such as the percentage of PIM factories that conduct at-source wastewater treatment. Furthermore, even though the basic legal system is in place, research is lacking on the conditions of industrial waste treatment, and the state and municipal environmental offices in charge of regulation must improve their structure and capacity to do so, thus it remains unclear as to how industrial waste from factories is actually being treated. As a result, there have been indications of Igarapé water pollution from factory effluent and environmental problems caused by illegal dumping of industrial wastes.

It is under these circumstances that the Superintendency of the Manaus Free Trade Zone (hereinafter, SUFRAMA) hopes to attract more industry to the MFZ/PIM and invite economic development of the MFZ with consideration for the environment. This has pushed toward the necessity to formulate a plan for industrial waste management for the entire PIM which could then be used to coordinate industries located there, construct an appropriate industrial waste management system and promote infrastructure provisions. For these reasons, SUFRAMA has sought assistance to obtain an accurate view of the current state of industrial waste management in the PIM and to formulate an appropriate master plan for industrial waste management.

In response to a request from the Government of the Federative Republic of Brazil (hereinafter, GOB), the Japan International Cooperation Agency (hereinafter, JICA)

[1] This indicates a group of factories located in the MFZ that receive tax benefits, including factories located both within and outside of the two industrial districts.

dispatched the second preparatory study team to clarify the framework of "The Study for the Development of an Integrated Solution related to Industrial Waste Management in the Industrial Pole of Manaus" (hereinafter, "the study"). The Minutes of Meeting (M/M) on the second preparatory study was signed on September 24th, 2008 and the Scope of Works (S/W) was signed on November 26th the same year.

To conduct the study, JICA selected Kokusai Kogyo Co., Ltd. and Ex Corporation in a joint venture as the consultants consigned to carry out the study operations. The joint venture began operations in February 2009, and the study is planned for completion in August 2010.

1.1.2 Objectives of the Study

The objectives of the study are:

- To review the current conditions of industrial waste management in the MFZ PIM and the surrounding area and compile the results into a report.
- To formulate a master plan for industrial waste management (five-year plan from 2011 to 2015) in PIM and guidelines for the improvement of industrial waste management in PIM.

Also, by achieving these study objectives, the following end goals are pursued.

- To establish appropriate industrial waste disposal and the 3Rs (Reduce, Reuse, Recycle) based on the master plan for industrial waste management in the target study area.
- With the establishment of appropriate industrial waste disposal and 3Rs, reduce improper disposal of industrial wastes and minimize environmental impact.
- To realize the above conditions, companies both domestic and foreign will be encouraged to enter PIM and create new employment opportunities.

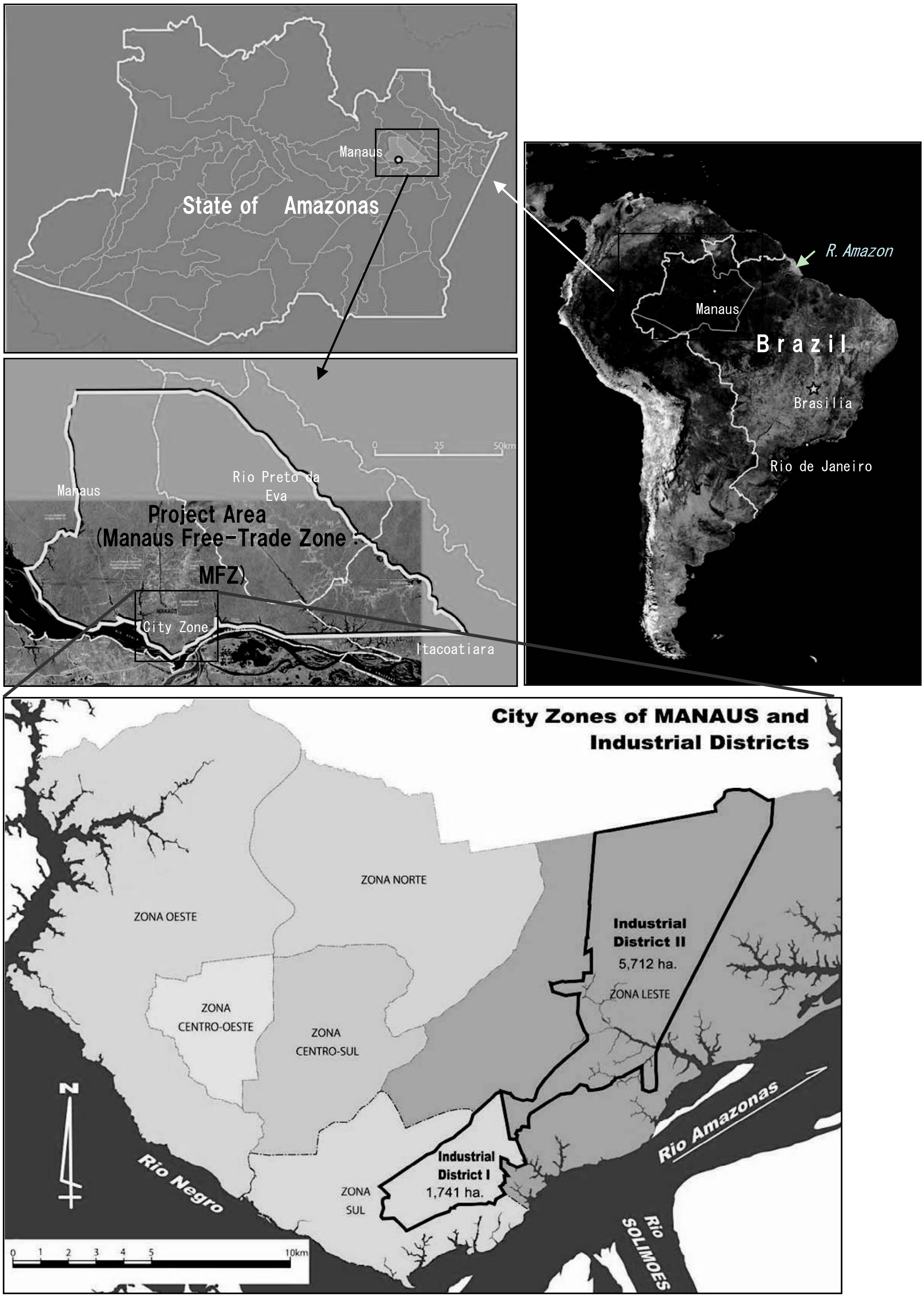
1.1.3 Study Area

The study area is the Manaus Free Zone (MFZ), where the PIM is located; at its heart, the City of Manaus, State of Amazonas (see map below). The MFZ, as detailed in the table below, is an area that enters three municipalities.

Table 1-1: Municipal Areas of MFZ

Name of Municipality	A. Municipal Area (km^2)	B. Area in MFZ (km^2)	Percentage of MFZ Area (B/A x 100 (%))
Manaus	11,458	4,950	43.2
Itacoatiara	8,600	1,250	14.5
Rio Preto da Eva	5,813	3,800	65.3
MFZ	-	10,000	-

Source: Brazilian Institute of Geography and SUFRAMA



Source: PERSPECTIVA, Amazonas Map

Figure 1-1: Map of the study area

1.1.4 Target Waste

The target waste in the study was industrial waste factories are required by CONAMA Resolution 313 to report upon making a waste inventory. Those wastes can be classified into 4 main categories, as shown below. Due to differences in the generation source and characteristics of each of these wastes, they were each surveyed individually in this study.

- General Industrial Waste
- Health-care Waste
- Construction Waste
- Radioactive Waste

The target waste of the study was the general industrial waste generated in the Industrial Pole of Manaus (PIM), but this also included waste such as health-care waste generated from medical institutions[2] linked to PIM factories and construction waste discharged from PIM construction sites. Improvement recommendations are not included in the master plan for radioactive waste, but a fact finding study of current conditions was conducted.

Each country has its own specific definitions and criteria for wastes. Each target waste in Brazil in this study, its definition, criterion and the entities which it targets are outlined in the table below.

Table 1-2: Target Wastes' Definition, Criteria and Corresponding Entities

Waste	Definition	Criterion	Target Entities
General Industrial Waste	Defined as factory-generated waste, roughly categorized as *production process* and *non-production process* waste.	CONAMA Resolution 313	All PIM factories
Health-care Waste	Health-care waste is defined as waste generated from medical institutions and is largely divided into the following 5 groups: Infectious (Group A: institutions, etc), Infectious (Group E: syringes, etc), Chemical (Group B) etc, Radioactive Waste (Group C), and Common (Group D) waste.	RDC 306/2004 – ANVISA (On-site), Resolution 358/2005 – CONAMA (Offsite)	Medical institutions (clinics) located at PIM factories and a SUFRAMA-approved hospital.
Construction Waste	Defined as construction-generated waste, roughly categorized as reusable or recyclable as aggregate, recyclable as non-aggregate, uneconomical recyclables, and hazardous waste.	CONAMA Resolution 307	Construction performed at all PIM factories.
Radioactive Waste	Material created through human activity, containing radioactive material at or above the limit set for radioactive licensing in CNEN-NE-6.02, defined as items unsuitable for, or impossible to, reuse.	CNEN-NE-6.05	All factories and organizations licensed by the Ministry of Science and Technology or the National Nuclear Energy Commission

2 The term "medical institutions" is used in the study in place of "hospitals", indicated in the Scope of Works (S/W).

	Waste which (1) emits beta or gamma rays, and (2) emits alpha rays, further categorized as liquid waste and solid waste. Also, each is regulated according to a low-level, mid-level and high level numerical range. Regulation is in place for allowable limits of alpha rays, although there is no such regulation for beta and gamma rays.		for Radioactive to use radioactive material in the study area.

1.2 Outline of the Study

1.2.1 Basic Policy of the Study

The study was implemented in accordance to the basic policy as follows.

The study team will implement the study according to the basic policy set forth below, as proposed in the IC/R and approved by the C/P.

The **industrial waste management plan** formulated in this study shall:

1. **be considerate of environmental protection wherever possible**
2. **be practicable**
3. **be understood by and obtain the cooperation of members of society**
4. **be formulated on the initiative of the Brazilian counterpart**

1. Consideration for environmental protection

The target area for the industrial waste management plan is the Amazon, a place where environmental protection has attracted global attention, and simply promoting appropriate treatment and disposal is not enough. Instead, it will be necessary to produce a plan that balances environmental protection and development (industrial activity). Such a plan will have to promote the 3Rs at the generation sources, preventing waste from being generated as much as possible, and stopping the illegal disposal through maximum reuse and recycling or energy conversion. In particular, the plan shall establish a ***material recovery network*** within the MFZ and aim for zero environmental impact from industrial waste generated in the area.

2. Practicability

It can not be overstated that establishing an adequate management system for industrial waste has great influence on further attracting industry and the continuation of development in MFZ. Nevertheless, no matter what the plan, it would be meaningless if not adhered to. Waste reflects the character of a society; regional differences are apparent in both the characteristics and amount of that waste. This means it is not possible to simply apply the economic and technical mechanisms used in Japan and other developed countries, but that a feasible master plan (M/P) must be formulated according to the circumstances of the study target area. In order to do so, there must be a proper understanding of the current waste management practices by the companies in PIM, the conditions concerning disposal of wastes generated by them, and the capability and capacity of related organizations and institutions.

3. Social understanding and cooperation

Industry raises their profits through production output, while at the same time society acquires the materials they need and enjoy wealth. Thus, the problem of industrial waste emerging from factory output is not solely the problem of industry, but an issue all members of society must bear. Society bears the expense through the cost of goods or taxes regardless of whether treatment and disposal is done by the industries that generate waste, or if the government has a hand in it. Without social understanding and cooperation, there will be obstacles to industrial waste management.

4. Brazil's initiative

As expected, the formulation and smooth implementation of the M/P will happen through close cooperation between the Brazilian counterpart and the study team. The Brazilian side, however, must take the initiative to conduct the study on its own. Also, part of the process to formulate a plan to improve industrial waste management in which "a study is carried out to grasp the current conditions and formulate a master plan based on the results" will not only serve PIM, but by formulating a model plan that can be applied to other industrial hubs, this should have a multiplied effect nation-wide. However, in order to actualize this effect, the Brazilian side will have to be proactive in their approach and take the initiative in conducting this study.

1.2.2 Approach of the Study

The study has been implemented according to the basic policies above, specifically, by carrying out the following central activities.

- Study development through weekly meetings
- Holding workshops and a seminar
- Publicizing activities on the SUFRAMA website
- Provide Japan Training to C/P

a. Study development through weekly meetings

There are a great number of different parties engaged in the study which deal with the management of the target wastes--industrial, health-care, construction and radioactive wastes--in the study. Also, the administrative authority of these parties may be redundant or unclear in some cases. Furthermore, to come to a proper understanding of the actual waste management practices carried out in PIM, the study has carried out a survey on generation sources such as factories, medical institutions, and construction sites, and a survey of waste service companies and related organizations. In order to implement these surveys properly in the limited study period, it was necessary to begin with a proper understanding of which organizations had existing data related to the study, how they have been managing it, and so forth. To do so, the concerned parties were called together for weekly meetings to discuss the progress of the study. These meetings allowed the concerned parties to discuss at least the forthcoming week's schedule, what other parties, if any, should be invited, and deliberate about the progress of the study. Namely, the meeting sought to involve not only dischargers of waste, but also participation from administrative organizations and waste service companies or NGOs and other related parties should their participation be necessary to the progress of the study.

In the weekly meetings, the counterpart (C/P) was the driving force behind formulating the M/P and promoting its implementation. Each week, about 26 participants in average attended and spent a couple hours to discuss the contents of the study and how it should proceed, in addition to why the study was necessary, and who put the results into practice and how. Through the discussions that took place during the weekly meetings, the participants from varying organizations came to understand each other's roles and were able plot out any necessary adjustments. Basically, this has formed a network of each party's information and personnel, and a network like this would likely be influential, particularly in promoting the implementation of the industrial waste master plan (M/P) formulated.

For each weekly meeting, the study team prepared discussion materials (hereafter, the agenda), SUFRAMA recorded the Minutes of Meeting (M/M), and these were then distributed to the Ministry of Environment, JICA Brazil Office and other related organizations. These agenda and M/M covered not only the progress of the study, but also all discussion items such as industrial waste management issues and policies for improvement. These are provided in the Data Book.

A total of 26 weekly meetings were held from March 3, 2009 to May 26, 2010, and were attended by a total of 646 related persons. The following table shows the breakdown of those attendees.

Table 1-3: Weekly Meeting Attendee Breakdown

Affiliation	Total Attendees
1. SUFRAMA (C/P)	278
2. Amazonas State Government Affiliate other than SUFRAMA (C/P)	127
3. Local Consultant	77
4. Generator (Industry)	2
5. Waste Service Company	10
6. JICA Study Team	150
7. Other	2
Total	646

b. Holding workshops and seminars

The weekly meetings are limited to participant organizations and their delegates. However, in order to achieve the understanding and hear the opinions of a wide range of stakeholders to understand the current conditions of industrial waste management and to formulate the master plan for industrial waste management, a series of workshops and a seminar were held to offer an opportunity for discussion, as outlined below.

Table 1-4: Workshops and Seminar Overview

Workshops and Seminars	Date	Purpose
1st Workshop	11 September 2009	Opinion gathering from stakeholders on the current conditions of industrial waste management and policy for improvement
2nd Workshop	27 November 2009	Present the concept of the Industrial Waste Management Master Plan, to explain the content to stakeholders and seek their opinions

3rd Workshop	6 April 2010	Plan for Industrial Waste Management M/P including selection of alternative plan, and exchange with stakeholders.
Waste Inventory Database (WI_DB) Seminar	7 April 2010	Present a summary of the WI_DB developed in the study to those responsible for completing the waste inventory on behalf of factories and actively seek their cooperation. Also, to receive any recommendations to improve database input methods and so forth.
Waste Service Company Database (WSC_DB) Seminar	7 April 2010	Present a summary of the WSC_DB developed in the study to waste service companies and seek their understanding of its intent. Also, to receive any recommendations to improve database input methods and so forth.
Seminar (in Manaus)	27 May 2010	Disclosure of all study results, including M/P, and forming consensus with stakeholders on spreading results and plan.
Seminar (in Brasilia)	28 May 2010	Present a summary of the WI_DB and WSC_DB developed in the study to federal government representatives and seek their understanding, as well as opinion concerning dissemination to other parts of the country.

Furthermore, it is ideal to reflect the opinions of as many stakeholders as possible in the Industrial Waste Management Master Plan (M/P). To do so, when formulating the M/P, three workshops and a seminar will be held, seeking the opinions of stakeholders, and reflecting them in the M/P upon analysis, as the following chart illustrates.

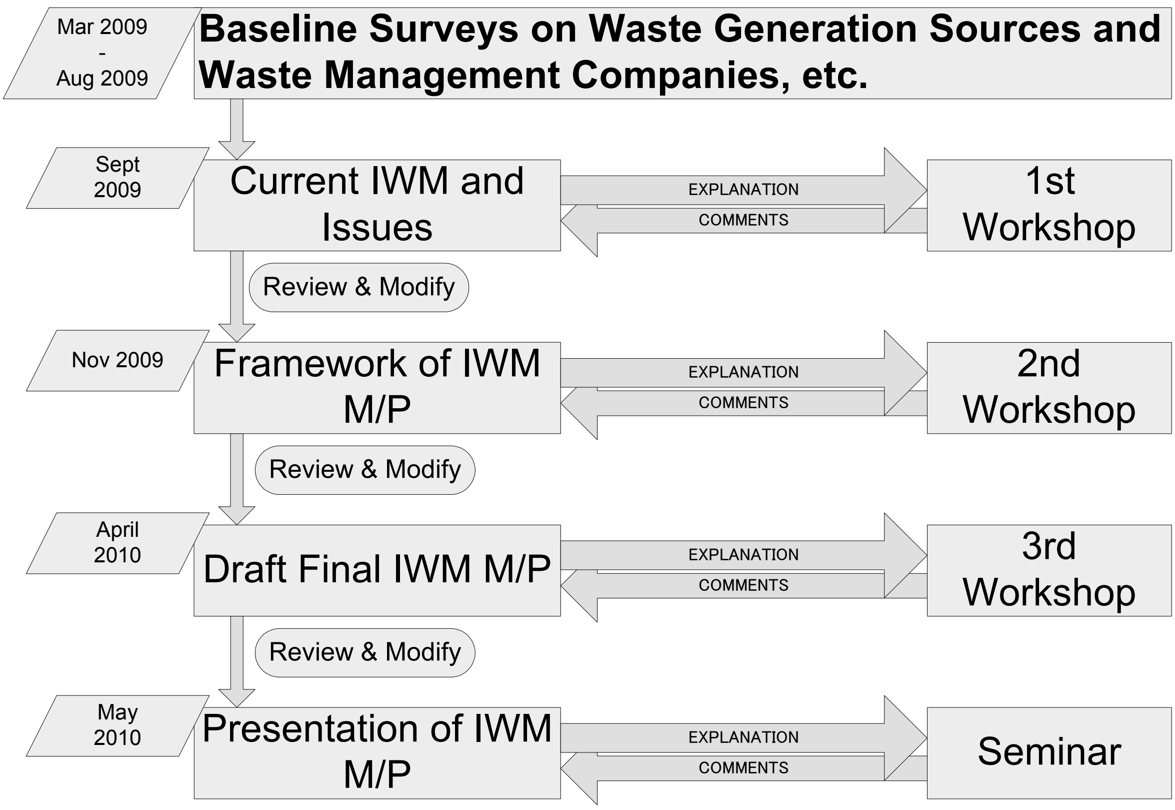


Figure 1-2: Formulation of the Master Plan through Workshops and Seminar

Based on this process, as mentioned in the basic policies earlier, this served to gain cooperation and understanding from society in formulating the plan, to promote disclosure of information and include environmental considerations in the plan.

At the three workshops and main seminar in Manaus, there were a total of 573 attendees. The breakdown of attendees is shown below.

Table 1-5: Workshops and Seminar Attendee Breakdown

Affiliation	1st Workshop	2nd Workshop	3rd Workshop	Manaus Seminar
1. SUFRAMA (C/P)	34	13	32	32
2. Amazonas State Government Affiliate other than SUFRAMA (C/P)	19	13	12	13
3. Local Consultant	12	3	4	2
4. Generator (Industry)	65	72	54	28
5. Waste Service Company	22	12	10	8
6. JICA & JICA Study Team	8	9	6	5
7. Other	21	16	24	24
Total	181	138	142	112

Moreover, additional seminars were held to explain the waste inventory database (WI_DB) and waste service company database (WSC_DB), which attracted 46 and 36 participants, respectively. Another seminar was held in Brasilia with 10 participants.

c. Publicizing activities on the SUFRAMA website

Progress of the study and reference information on industrial waste has been put on the SUFRAMA website. The following information, mainly in the form of newsletters, was posted, as of the end of July.

Table 1-6: Content of the Information Posted on the SUFRAMA website

Type of Information	Date Posted	Contents
Newsletter 1	Late April 2009	Overview of the study
Newsletter 2	Late June 2009	Purpose and overview of the generation sources survey and survey of waste management companies
Workshop (1)	Mid September 2009	Workshop (1) Presentation Materials
Newsletter 3	Mid October 2009	Results of Waste Generation Source Survey, Waste Service Company Survey
Newsletter 4	Mid November 2009	Overview of Workshop (1)
Workshop (2)	Early December 2009	Workshop (2) Presentation Materials
Newsletter 5	Mid February 2010	Overview of Workshop (2)
Workshop (3)	Early April 2010	Workshop (3) Presentation Materials
Newsletter 6	Mid June 2010	Overview of Workshop (3) and explanatory meetings on the Waste Inventory and Waste Service Company databases.
Seminar in Manaus	Mid June 2010	Seminar Presentations Materials
Newsletter 7	Late July 2010	Overview of the Seminar

d. Japan Training for C/P

The Industrial Waste Management Master Plan (M/P) formulated in the study will be implemented by related organizations on the Brazilian side, starting with the C/P. In the M/P, various improvement plans were proposed, given actual conditions in Manaus, some of the matters in the proposal required further comprehension. Thus, the decision was made that it was necessary for the C/P to acquire knowledge related to the following items in order to bring about the smooth implementation of the M/P, and to understand conditions in Japan, training was carried out in Japan.

- The background and state of implementation of zero emission factories and industrial complexes
- Necessities to promote 3R
- Proper operation of various types of industrial waste treatment and disposal facilities
- The established state of a material cycle network centered around a cement factory

The training took place over an 18-day period from January 24 to February 10, 2010, attended by 5 C/P members who will be central to implementing the M/P.

Table 1-7: Japan Training Participants

Name	Affiliation	Post
David Rocha Silva	SUFRAMA	Waste Management Unit will establish 2010
Armando Bandeira dos Santos Jr	SUFRAMA	Waste Management Unit will establish 2010
Rita de Cássia de Vasconcelos Dias Mariê	SUFRAMA	Waste Management Unit will establish 2010
António Ademir Stroski	IPAAM	Assessor
Alexandre Kadota	FIEAM/CIEAM/CCINB-AM	Co-Director

1.2.3 Organizations of the Study

a. Organization Structure of the Study

SUFRAMA has designated members that make up the counterpart (C/P), steering committee (St/C) and technical consultative sub-committee (TCSC) to encourage smooth implementation of the study. At the same time, JICA has established an advisory committee in Japan to support the study team. The structure of these organizations in relation to the study is shown in the figure below.

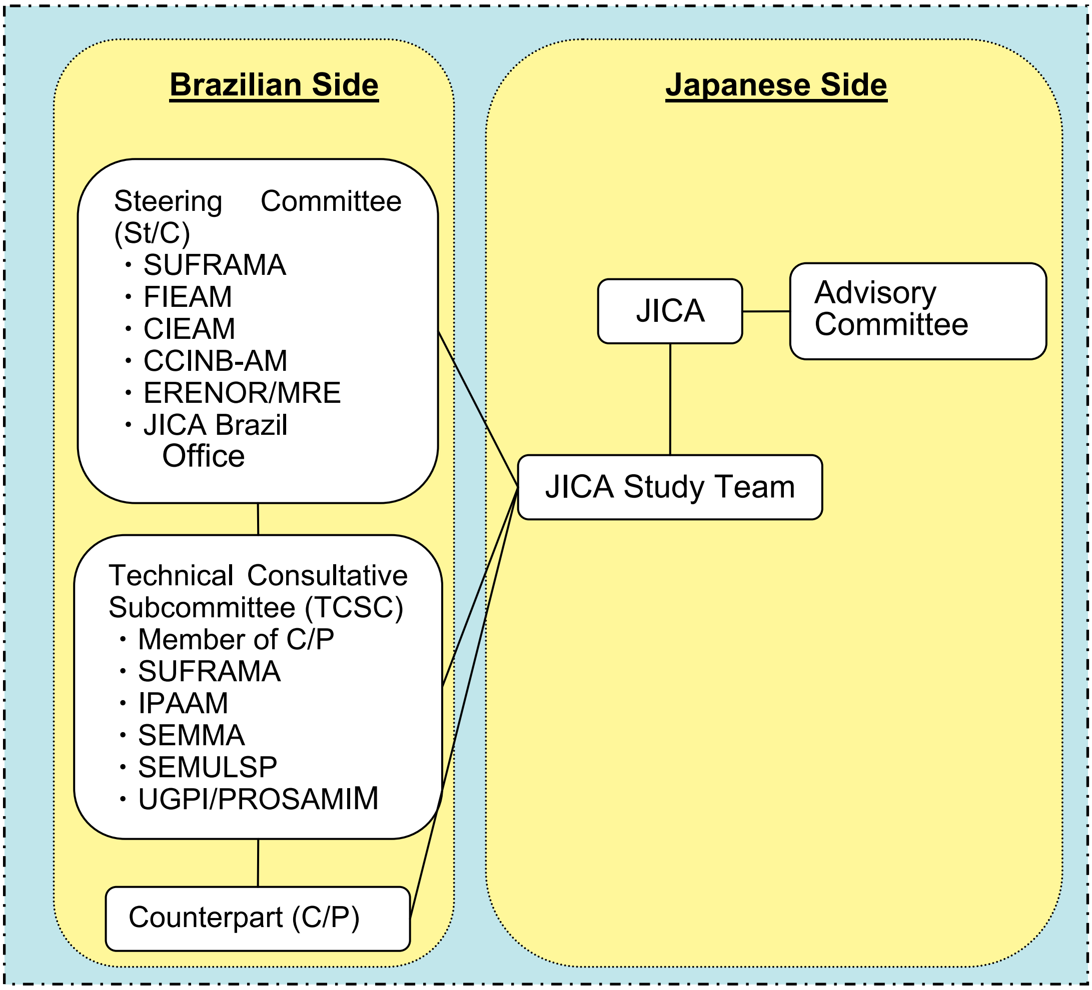


Figure 1-3: Organizational Structure of the Study

b. Brazilian Side

b.1 Members of Counterpart (C/P) Team

Members of Counterpart (C/P) Team are as follows:

Table 1-8: Members of Counterpart (C/P) Team

No.	Name	Position	Organization
01	Keithy Garcia	Technical Advisor	SUFRAMA
02	Mônica E. C. Barros	Attorney	SUFRAMA
03	Armando Bandeira Jr.	Technician	SUFRAMA
04	Armando Rubens Lima	Technician	SUFRAMA
05	Neyla Saraiva	Fishing Engineer	SUFRAMA
06	Adamilton Mourão	Administrator / Architect	SUFRAMA
07	Maria Helena P. Roza	Engineer	SUFRAMA
08	Diego Alves Amoêdo	Electronic Engineer	SUFRAMA
09	Márcia Ribeiro	Administrator	SUFRAMA
10	Miber Jucá	Technician	SUFRAMA
11	Érica Lira	Secretary	SUFRAMA

12	Anita Zambrano Acuña	Assessor	ERENOR
13	David Rocha Silva	Electronic Engineer	SUFRAMA
14	Rita de Cássia de Vasconcelos Dias Mariê	Engineer	SUFRAMA

b.2 Members of the Steering Committee (St/C)

Members of the Steering Committee (St/C) are shown in the following table.

Table 1-9: Members of the Steering Committee (St/C)

No.	Name	Position	Organization
01	Maria Gracilene Roberto Belota	General Coordinator	SUFRAMA
02	Luis Flávio Simões	Project Coordinator	SUFRAMA
03	Carlito Holanda	Coordinator	SUFRAMA
04	Flávio José Dutra	Executive Director	FIEAM
05	Alexandre Kadota	Adjunct Director	FIEAM
06	Ronaldo Mota	Executive Director	CIEAM
07	Mário Susumu Okubo	Vice-President	CCINB-AM
08	Iuquio Ashibe	Vice-President	CCINB-AM
09	Gustavo Resende Mendonça	Cooperation Technician	ABC/MRE
10	Wófsi Yuri G. de Souza	Cooperation Technician	ABC/MRE
11	Henrique Jenné	Chief	ERENOR
12	Mauro Inoue	Project Coordinator	JICA Brazil Office

b.3 Members of Technical Consultative Subcommittee (TCSC)

Members of Technical Consultative Subcommittee (TCSC) are as follows:

Table 1-10: Members of Technical Consultative Subcommittee (TCSC)

No.	Name	Position	Organization
01	Maria Gracilene Roberto Belota	General Coordinator	SUFRAMA
02	Luís Flávio Simões	Project Coordinator	SUFRAMA
03	Carlito de Holanda Sobrinho	Coordinator	SUFRAMA
04	Neliton Marques da Silva	President-Director	IPAAM
05	Antonio Ademir Stroski	Assessor	IPAAM
06	Marcelo Dutra	Secretary	SEMMA;SEMULSP
07	Clive Reis do Nascimento	Assessor	SEMULSP
08	Jane Crespo	Environmental Sector Coordinator	UGPI/PROSAMIM
09	José Lúcio Rabelo	Institutional Sectorial Coordinator	UGPI/PROSAMIM

c. Japanese Side

c.1 Members of the JICA Advisory Committee

The members of the JICA Advisory Committee are as follows:

Table 1-11: Members of the JICA Advisory Committee

Role	Name	Affiliation
Chairman	Dr. Mitsuo Yoshida	Japan International Cooperation Agency (JICA), Senior Advisor (Environment, Waste, Geology)
Committee Member	Dr. Haruo Matsumura	Japan Industrial Waste Technology Center, International Cooperation, Director

c.2 Members of the Study Team

The members of the Study Team are as follows:

Assignment	Name
Leader / Institutional Development	Susumu Shimura
Waste Generation Source Management (1)	Tamotsu Suzuki
Waste Generation Source Management (2)	Ichiro Kono
Industrial Waste Disposal Planning	Jose Felicio Haddad
Economic and Financial Analysis	Satoshi Sugimoto
Environmental / Social Consideration	Masaharu Kina
Promotion of Waste Management Industry	Shoji Nakamura
Promotion of Waste Management Industry	Minoru Sawachi
Administrative Coordinator	Steven Sundstrom

1.2.4 Study Schedule

a. Overview of study work schedule

The study is divided into two phases, starting in February 2009, and concluding in August 2010:

Phase 1: Study of current conditions (February 2009 - September 2009)

Phase 2: Formulation of the industrial waste management master plan and guidelines (October 2009 – August 2010)

An overview of the work schedule is illustrated below.

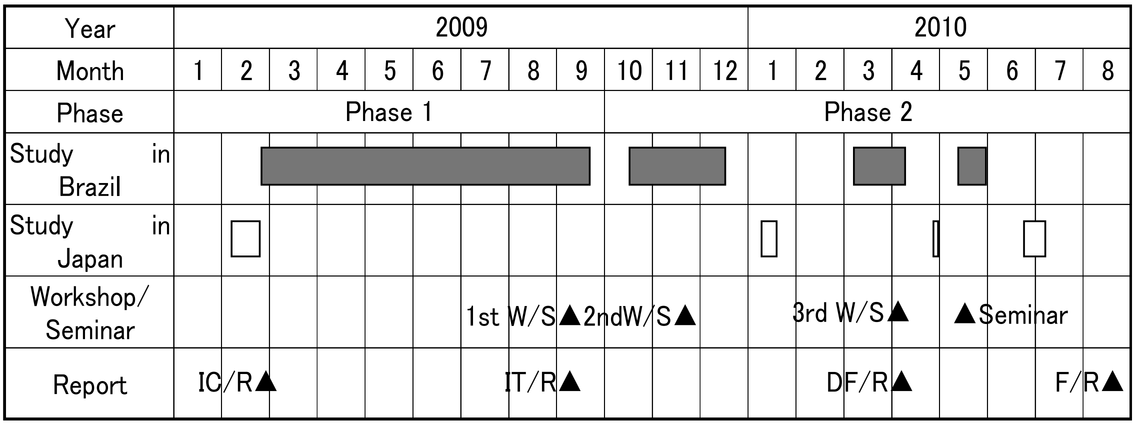


Figure 1-4: Overview of study work schedule

b. Plan of Operation

The primary work items to be carried out in the study, as aligned with the above work schedule, are given below.

<u>Phase 1: Study of Current Conditions</u>

A. Preparatory Work (Feb 2009)

A.1 Collection and Analysis of Data and Information

A.2 Overall Examination of Basic Policies, Content and Methods of Study

A.3 Preparation of Inception Report

A.4 Preparation for First Works in Brazil

B. First Works in Brazil (Feb – Sept 2009)

B.1 Presentation of IC/R and Discussion of Study Plan

B.2 Conduct Study on Current Conditions

B.2.1 State of Study Area (PIM, Manaus, Amazonas)

B.2.2 State of Environmental Management

B.2.3 State of Waste Management and Issues to be Solved

B.3 Supplement Studies on Current Conditions

B.3.1 Survey of Waste Management Companies

B.3.2 Survey on Generation Sources

B.3.3 Conducting the Survey on Environmental and Social Considerations

B.3.4 Development of a Waste Management Database

B.4 Preparation, Submission and Discussion of Interim Report

B.5 Workshop (1)

Phase 2: Formulation of the Industrial Waste Management Master Plan and Guidelines

C. Second Works in Brazil (October – December 2009)

C.1 Formulating the Master Plan

C.1.1 Estimating Amount of Industrial Waste Generated

C.1.2 Goal Setting

C.1.3 Basic Strategy Formulation

C.1.4 Formulating a Draft Master Plan

C.2 Development of a Waste Exchange Database

C.3 Workshop (2)

C.4 Conducting IEE

C. 5 Creation of Framework for Draft Guidelines

D. First Works in Japan (December 2009)

D.1 Submission of 1st Draft Final Report and 1st Draft Guidelines

E. Third Works in Brazil (March – April 2010)

E.1 Follow-up Study on the Master Plan

E.2 Follow-up Study on Draft Guidelines (DG/L)

E.3 Submission of 2nd Draft Final Report (DF/R) and 2nd Draft Guidelines

E.4 Workshop (3)

F. Second Works in Japan (April 2010)

F.1 Completion of Draft Final Report

G. Fourth Works in Brazil (May 2010)

G.1 Discussion on Draft Final Report and Draft Guidelines

G.2 Seminar

H. Third Works in Japan (June 2010)

H.1 Submission of Final Report and Proposed Guidelines

The work schedule is detailed in the following figure.

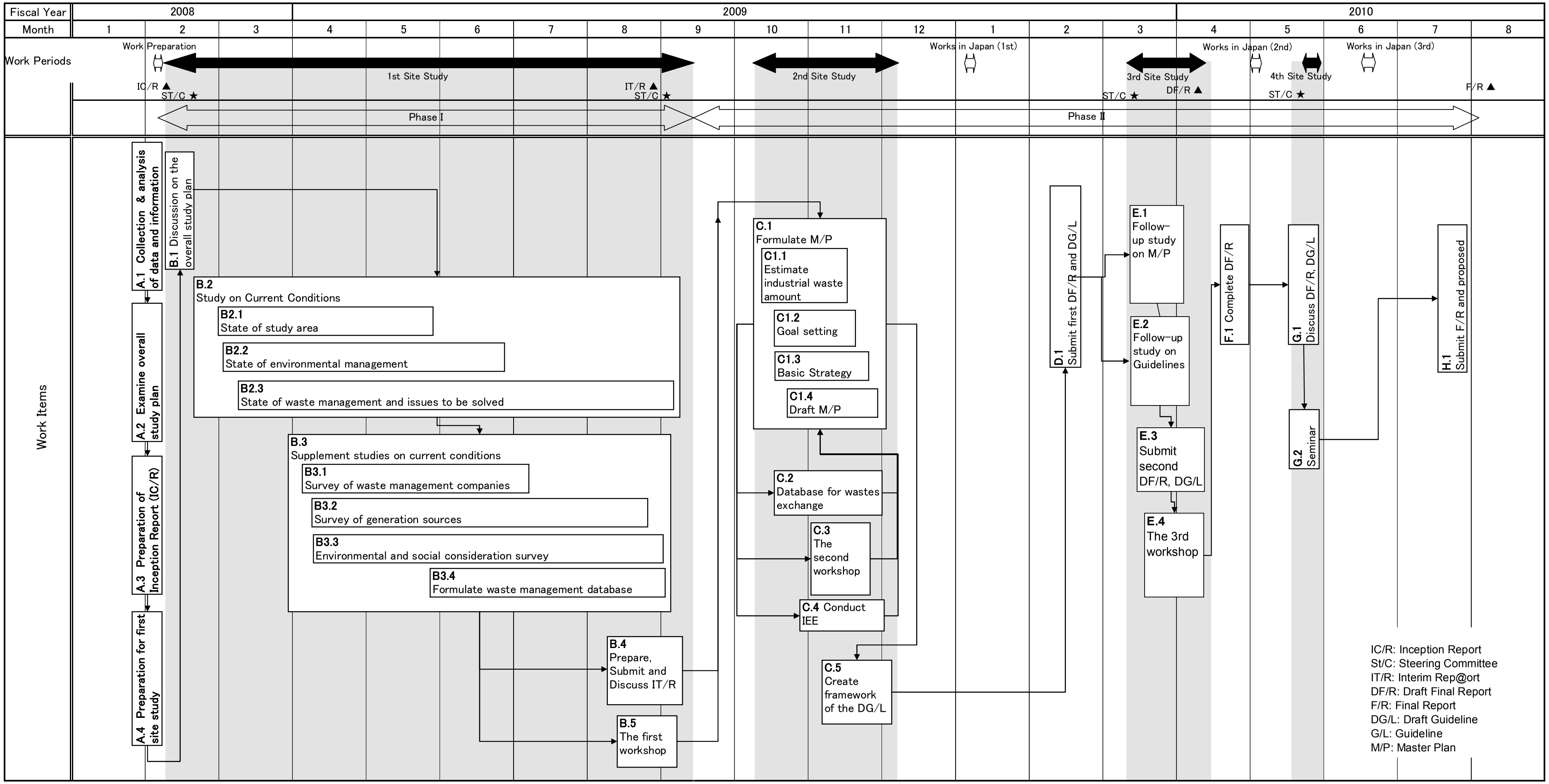


Figure 1-5: Detailed Work Schedule

1.2.5 Overview of the Study

The study is summarized as follows.

a. Phase 1: Study of Current Conditions (February 2009-September 2009)

First, in order to comprehend the current conditions of industrial waste management in the study target area, the following supplemental studies were carried out.

1. Waste Generation Source Survey

- Survey of 187 PIM factories which generate industrial waste
- Survey of 10 PIM medical institutions which generate medical waste
- Survey of 10 PIM factories which performed construction projects over the past one-year period which generated construction waste.
- Survey of 8 PIM institutions which use radioactive materials and generate radioactive waste

2. Study of current waste management conditions for 90 waste service companies

Prior to implementing the studies, the current conditions of industrial waste management in the State of Amazonas, and particularly the legal system related to the types of waste and what organizations manage them, was investigated through cooperation with the C/P. Then, each of the survey items, target factories and companies were discussed with those concerned at weekly meetings and questionnaires for each survey were produced. Based on these, with the exception of radioactive wastes, a tender was carried out for each of the 4 surveys and local consultants were consigned accordingly. The radioactive waste survey was done by the study team and in cooperation with a survey assistant.

- For each survey, the local consultant visited a sample group to carry out the survey based on the questionnaire, then summarized the results. The study team analyzed these results and created a waste stream diagram for general industrial waste, health-care waste and construction waste, and outlined the conditions and issues related to waste management. Concerning radioactive waste, it was discovered that there is no radioactive waste generated.
- Upon discussion with those concerned at the weekly meetings, the current conditions and issues of industrial waste management in PIM were organized. Workshop (1) was held on September 11, 2009 to present this to stakeholders and solicit their opinions. A total of 181 people participated in Workshop (1), and after the above was presented by the C/P, attendees were divided into three groups where they proceeded to discuss these. Afterwards, a representative from each group presented the issues of industrial waste management and policies for improvements as discussed in their groups.
- Based on the conclusions and suggestions from Workshop (1), the study team and C/P summarized the output of Phase 1 in an Interim Report (IT/R).

b. Phase 2: Formulation of the industrial waste management master plan and guidelines (October 2009-August 2010)

Phase 2 of the study started at the end of October 2009, beginning with discussion of in what ways the issues of industrial waste management in PIM, as found in phase 1 of the study, should be approached for improvement. Discussing with related stakeholders in weekly meetings, a policy was produced for improving these issues by conceiving of the concept for an Industrial Waste Management Master Plan (M/P). On November 27, 2009, Workshop (2) was held, attended by 137 stakeholders. After the C/P presented the concept of the Industrial Waste Management M/P, participants divided into two groups for active discussion on the topic. Afterward, a representative from each group presented the conclusions related to the IWM M/P as discussed in the groups.

It was planned, during this time, to carry out an Initial Environmental Evaluation (IEE), but was it was ultimately decided to forego the IEE after it was confirmed that the preparation of waste related facilities required in the M/P were basically left to the hand of private companies and the government side is not involved.

From the end of October 2009 to early December, along with the formulation of the M/P concept, the following two databases, which are extremely significant toward improving upon issues of industrial waste management, were developed through discussion with SUFRAMA and IPAAM related staff.

1. Industrial Waste Inventory Database (WI_DB)
2. Waste Service Companies Database (WSC_DB)

In January and February 2010, in Japan, the study team arranged the details based on the concept of the M/P. Also, from late January to mid-February, spanning approximately 3 weeks, support was given for Japan training for the five members of the C/P. Through the Japan training, the C/P member's understanding of the improvements recommended in the M/P was greatly strengthened.

The third study period in Brazil was carried out from early March to early April 2010. During that time, 4 weekly meetings were held, at which participants discussed the details of the M/P and the content of the (draft) guidelines to improve industrial waste management in PIM, on which the Draft Final Report (DF/R) was based. Agreement was sought with as many stakeholders as possible over the content of the proposed M/P in the DF/R by holding Workshop (3) on April 6, 2010. At the workshop, the five members of the C/P who had received training in Japan presented three themes, on-site and off-site industrial waste management as well as IWM administration in Japan, so that participants could comprehend the content of the proposed M/P. In addition, a representative of the C/P explained the proposed M/P and then took comments and suggestions from the audience. There were 142 participants at Workshop (3), and following the presentation on the proposed M/P, participants were divided into small groups where they proceeded to actively discuss the topics. Then, a representative of each group gave a summary of what was discussed in their group concerning the proposed Industrial Waste Management Master Plan.

In the third study period in Brazil, a user guide was made concerning data input and management of the industrial waste inventory database (WI_DB) and waste service company database (WSC_DB) which is the framework to the (draft) guidelines to improve industrial waste management in PIM. Then, in order to ensure the effective use of these databases and facilitate IWM improvements, those related to these databases (the factory employees in charge of making the WI at factories for the WI_DB, and waste service company (WSC) applicants for operation licenses (OL)) were invited to respective seminars to give an overview of the databases, explain the user functions and garner opinion. The seminars for the WI_DB and WSC_DB attracted 46 and 36 participants respectively, who discussed the databases and content of the user manuals.

From mid-April to mid-May 2010, based on the results of group discussions at Workshop (3), the Study Team discussed the content of the DF/R with related parties at JICA headquarters and made the suggested improvements to the DF/R while in Japan.

Starting in mid-May 2010, until the end of the month, the Team carried out the fourth study period in Brazil. A Steering Committee (St/C) meeting was held on May 24th, as well as two weekly meetings, to discuss improvements to the DF/R, all of which was recorded in meeting minutes. Then, in order to form agreement on the M/P, a seminar was held in Manaus on May 27, 2010 to disclose and publicize the Study results. A total of 112 stakeholders attended the seminar and actively participated in opportunities to offer comments and ask questions.

Also during the fourth study period, the Team assisted the C/P to enter the 2010 waste inventory (WI) data received into the WI_DB developed in the study. Through this process, the C/P understood the need to work closely with those who would complete the WI at factories and gain their support in order to effectively operate the WI_DB, as well as the value in providing training to factory officers and making them aware of the WI_DB user guide. Given the results, and the importance of the 2 databases, the WI_DB and WSC_DB, a seminar was held in Brasilia on May 28 for the purpose of disseminating these beyond Amazonas State to other states in Brazil. Ten participants gathered at the seminar in Brasilia and the officers in charge of managing the respective databases from IPAAM and SUFRAMA explained issues pertaining to their purpose and functionality.

The Team finalized the Final Report (F/R) in Japan from June to early August 2010 based on the results of group discussions at Workshop (3) and suggestions received at the seminars, in addition to comments from Brazilian counterparts and JICA headquarters, and submitted the report to JICA headquarters.

1.2.6 Reports

The following reports were prepared, presented, discussed and submitted to the Brazilian side:

Table 1-12: Reports Submitted

Report	Language/Format	No. of Copies
Inception Report ＜IC/R＞	English	10
	Portuguese	10
	CD-ROM	1
Interim Report ＜IT/R＞	English summary	10
	English main report	10
	Portuguese summary	10
	Portuguese main report	10
	CD-ROM	1
Draft Final Report ＜DF/R＞	English summary	10
	English main report	10
	English supporting materials	10
	English databook	10
	Portuguese summary	10
	Portuguese main report	10
	Portuguese supporting materials	10
	CD-ROM	1
Final Report	English summary	20

＜F/R＞	English main report	20
	English supporting materials	20
	English databook	20
	Portuguese summary	40
	Portuguese main report	40
	Portuguese supporting materials	40
	CD-ROM	1

2. Profile of the Study Area

2 Profile of the Study Area

2.1 Natural, Social and Economic Conditions

2.1.1 Natural Conditions

Brazil has a total area of 8,514,877 sq km (about 23 times the size of Japan) and a population of 184 million (2005). The study area is the Manaus Free Trade Zone (hereafter, MFZ), which is located in northwest Brazil in the eastern part of Amazonas State. Amazonas State is the largest of nine states that constitute the Legal Amazon. Of those, the states of Amazonas, Acre, Rondonia, and Roraima make up what is known as the Occidental Amazon, which covers an area of 2,195,000 sq km, which is 25.7% of Brazil's total area. Amazonas State itself is an expansive 1,577,820 sq km, more than four times the size of Japan, yet with a population of merely 3.3 million (2008), only 2.7% the population of Japan's. The Amazon forest, the world's largest rainforest, covers most of the state.

The MFZ is located at 3 degrees southern latitude, 60 meters from the sea, in the world's largest basin area along the Amazon River, which empties into the Atlantic Ocean and which is the source of 20% of the world's river water. On the left bank of the MFZ is the Rio Negro, the largest tributary of the Amazon, which comes together with the Rio Solimões in the eastern area of Manaus to form the Amazon. Rainforest is located in the northern area of the MFZ, with an average annual rainfall of 2,087.5mm, an average temperature of 28.7°C (83.6°F), and extremely high average humidity of 82%. The rainforest is a dense collection of tall evergreen broad-leafed trees, and the largest collection of plant variety with several hundred different types per hectare. Likewise, the rainforest is home to various insects and fish, a diverse collection of fauna said to be a cornucopia of genetic resources.

2.1.2 Social Conditions

a. Administration and Population

MFZ is located across three different municipalities, as shown in the map below: Manaus, Itacoatiara, and Rio Preto da Eva. The total area of MFZ is 10,000 sq km, over half of which is the city of Manaus at 4,950 sq km. The area and population of these three local governments is as follows.

Table 2-1: Area, Population and Pop. Density of Amazonas State, Manaus, Itacoatiara and Rio Preto da Eva (2008)

Name of Municipality	Area (km^2)	MFZ Area(km^2)	Population	Pop. Density (per/km^2)
Manaus	11,401	4,950	1,709,010	149.90
Itacoatiara	8,600	1,250	87,896	10.22
Rio Preto da Eva	5,813	3,800	26,004	4.47
A. Total (of 3 cities)	25,814	10,000	1,822,910	70.62
B. Amazonas State	1,577,820	-	3,341,096	2.12
Ratio of three cities area of Amazonas State (A/B)	1.64%	0.63%	54.6%	-

Source: IBGE (Brazilian Institute of Geography and Statistics): population estimates, July 2008

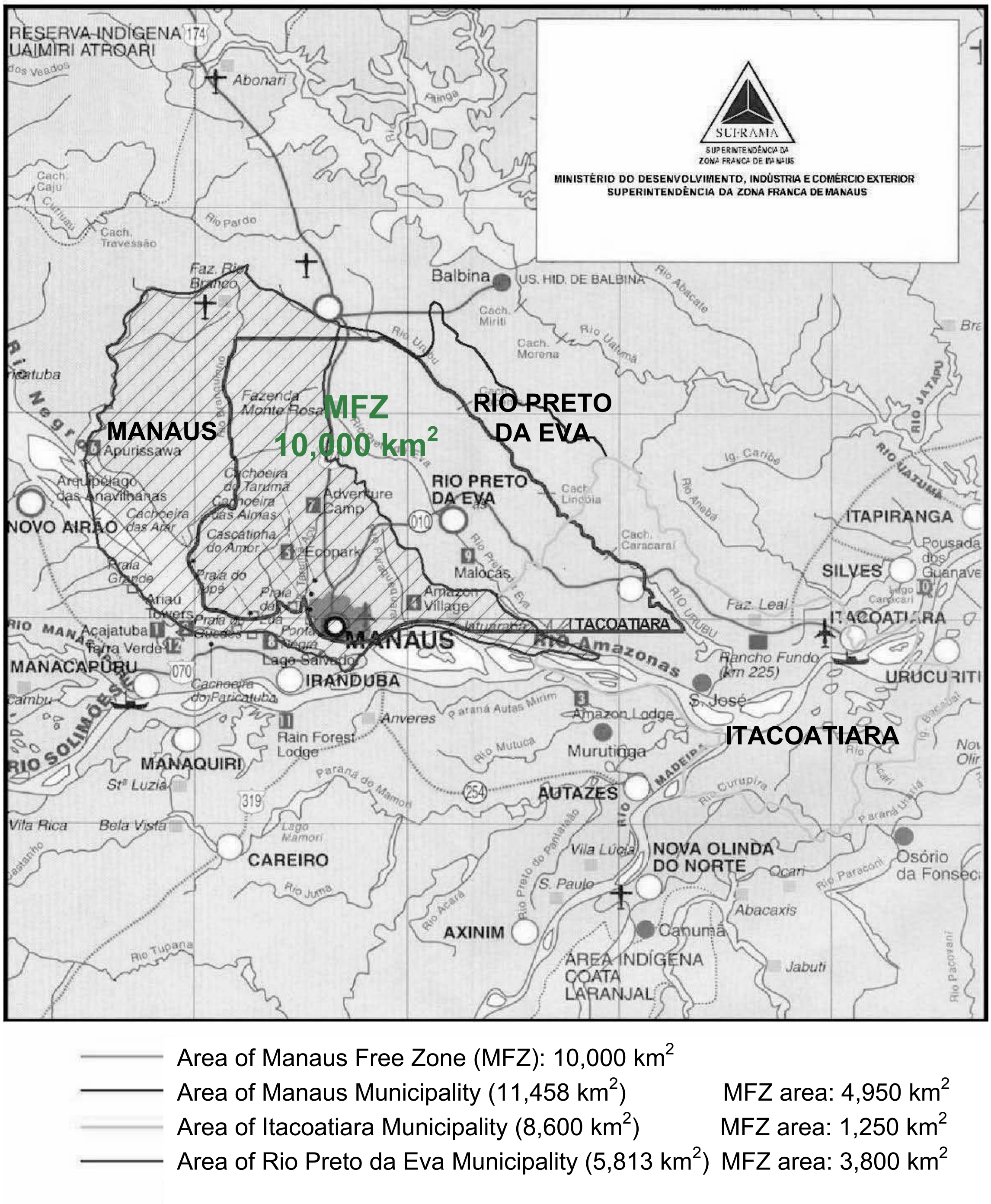
As shown in the above table, the area of the three cities where the MFZ is located is only 1.64% of Amazonas State, yet it contains over half (54.6%) of the population. This is a clear indication that industry in the state is centralized in PIM/MFZ.

Further, looking at the shift in population of Manaus, the capital city of Amazonas State and the heart of PIM/MFZ, the 1967 presidential order to establish MFZ shows a striking increase in the city's population (an influx of people from other regions and so on). At present, Manaus is Brazil's seventh largest city by population.

Table 2-2: Change in Manaus City Population

Year	1920	1940	1950	1960	1970
Population	75,704	106,399	139,620	175,343	311,622
Year	1980	1991	1996	2000	2008
Population	633,833	1,011,501	1,157,357	1,405,835	1,709,010

Source: IBGE



Source: SUFRAMA

Figure 2-1: Location Map of the Manaus Free Trade Zone (MFZ)

SUFRAMA's jurisdiction has increased from the development of four states to five with the addition of the State of Amapa. The Industrial Pole of Manaus (PIM), where SUFRAMA is headquartered, is the most developed region.

PIM refers to a group of factories that receive tax benefits by being located in the MFZ. Most of these PIM factories are located in Manaus. As shown in the map below (Figure 2-2: Manaus Industrial Districts (DI)), two industrial districts (DI) have been set up in Manaus, where SUFRAMA has laid roads, electrical lines and other infrastructure. The areas of

Industrial District 1 (DI I) and Industrial District 2 (DI II) are 1,712 ha and 5,712 ha, respectively.

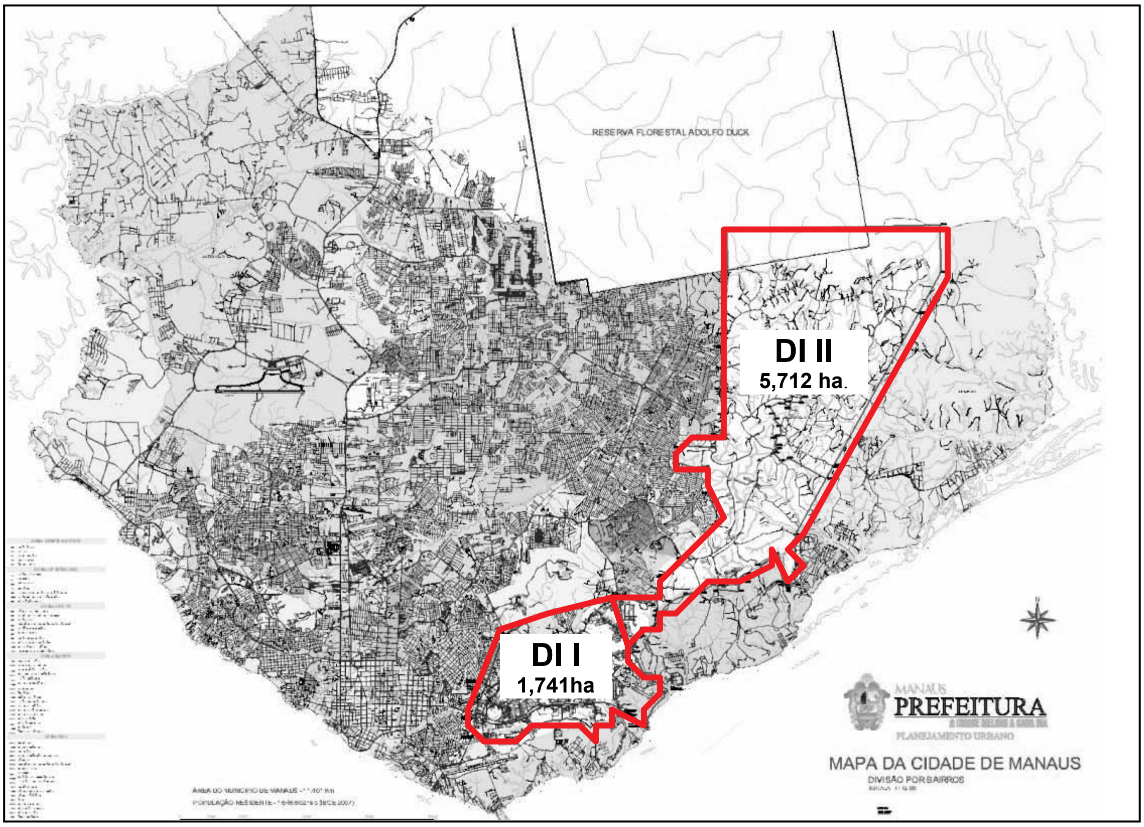


Figure 2-2: Manaus Industrial Districts (DI)

b. Infrastructure

The large river port and harbor serve as the transportation infrastructure of MFZ, where large ships can dock to unload their cargo. A transportation network has been developed upstream by the small and larger ports along the Amazon tributaries, the Rio Negro and Rio Solimões.

For air transport, Manaus is connected to a domestic and international network through Eduardo Gomes International Airport.

There is no railroad, so land transportation depends on delivery by road. Although plans for a mono-rail are in the works as part of preparations to host the World Cup in 2014, the main mode of transportation is bus. There is a road network of national, state and municipal roads, with an expressway pending completion. Also, a bridge is currently being constructed over the Rio Negro, but at present there is no land crossing over the Rio Solimões, where the Negro meets the Amazon.

The utilities in the city area of the MFZ are electricity, communications (telephone), water and sewer systems. However, only a combined sewer network is in place with no treatment facility, so untreated sewage is released through the Igarapé into the Amazon.

In the two industrial districts, SUFRAMA has built the trunk roads along which electrical lines have been laid, but water and sewer systems are only present at the more advanced factories.

2.1.3 Economic Conditions

a. National Economy

In Real (Brazilian currency), the Gross Domestic Product (GDP) for the country according to the latest data from the Central Bank of Brazil in 2008 at current price is R$ 2.9 trillion, (US$1.6 trillion). The Brazilian economy has been showing 4.7% annual growth on average for the past five years (2004 ~ 2008) and a per capita GDP of R$ 15,240 (US$8,230) in 2008.

By economic sector, the highest rate of GDP in 2006 was for the tertiary (service) sector at 69.6%, followed by the secondary sector (mining, manufacturing and construction) at 25.0% and the primary sector (agriculture, forestry and fisheries) at 5.4%.

b. Regional Economy

b.1 State of Amazonas

The regional GDP of Amazonas State for 2006 was approximately R$ 39.2 billion. Per capita GDP for that year was R$ 11,829, the highest in northern Brazil.

The tertiary sector is the largest component of the regional GDP at 50.4%, followed by the secondary sector at 44.6%, nearly twice that of the national average. In particular, the proportion of manufacturing in the region is high at 36.8%, a unique aspect of the economy of the State of Amazonas.

b.2 Manaus City

The regional GDP in the City of Manaus for 2006 at current price was approximately R$ 32 billion, central to the state's economy at approximately 86% of Amazonas' GDP. Manufacturing from the secondary sector is about 53% of the city's GDP, while the service sector is around 47%. The primary sector, on the other hand, accounts for only 0.2% of the total GDP in Manaus. In 2006, per capita GDP in Manaus was R$ 18,902, outweighing national per capita GDP.

Development of Manaus in the past few decades has been centred on the Manaus Free Trade Zone (MFZ), which was introduced through federal government investment incentives and various tax benefit schemes. Today most major electronics manufacturing is located here, such as the world's premier cell phone company Nokia.

c. Manaus Free Trade Zone (MFZ)

c.1 Background of MFZ

The MFZ was created in 1967 by the Federal Government of Brazil through Decree-Law No. 288 with the objective of creating employment and stimulating manufacturing activities, as a tool of promoting socio-economic development in the Western Amazon Region.

This development model was introduced to achieve the social and economic development of the region by offering various investment incentives to encourage manufacturing and industry, as well as agro-industry and commercial investment, while also sustaining the rich biodiversity in the area.

The fiscal incentive policy is administered by the Superintendence of the Manaus Free Trade Zone (hereafter, SUFRAMA), a Federal Government body attached to the Ministry for Development, Industry and Foreign Trade.

c.2 Investment Incentives in MFZ

There are various special incentives available for investment in the Manaus Free Trade Zone. An applicant company must fill out and submit detailed information sheets about their business activities and production processes to SUFRAMA in order to be approved and receive these incentive benefits. This policy also helps to ensure that the applicant companies are not simply limited to bottling, wrapping or conditioning operations, so-called free-riders.

Once an enterprise is approved by SUFRAMA, it becomes eligible to receive various federal, state and municipal tax and tariff incentives.

c.3 Industry in the SUFRAMA (PIM) Area

As of June 2009, 736 companies have been approved by SUFRAMA, of which 494 have already begun operations, whereas the remaining 242 are currently preparing to begin full operations. The total number of workers employed by the above projects is estimated at 138,000 workers, with a total investment of some 14.2 billion US dollars.

Table 2-3: Enterprises Approved by SUFRAMA (July 2009)

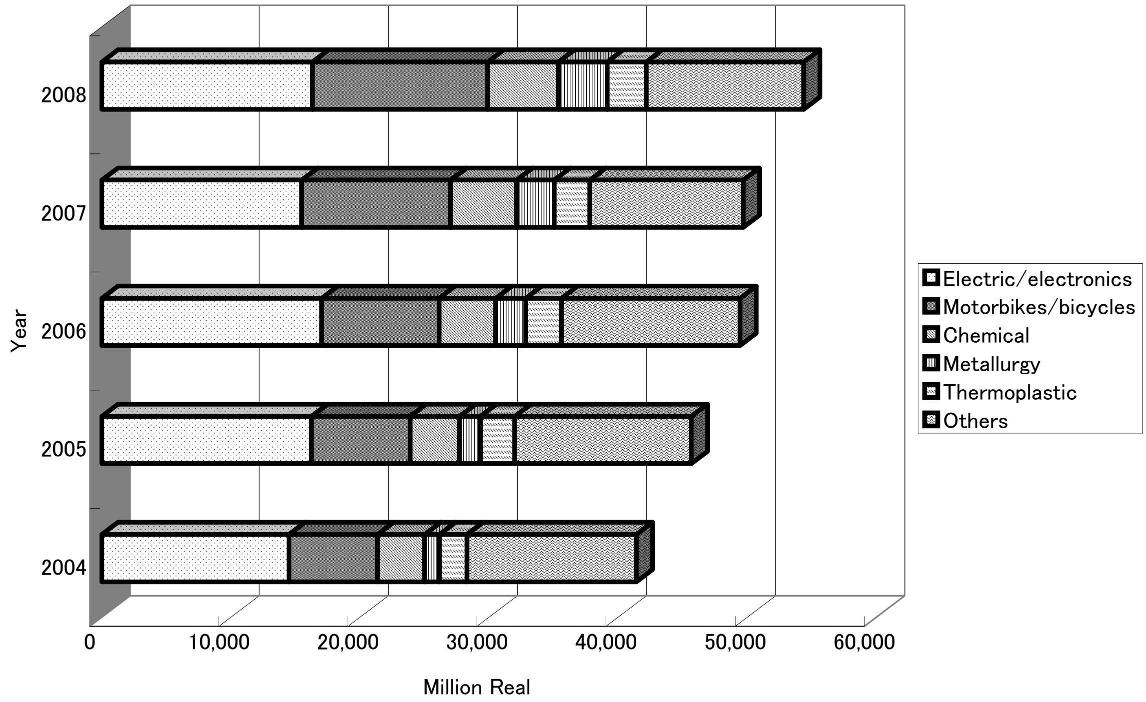
Projects	Enterprises in Operation			Enterprises in Preparation			Total		
	No. Enterprises	No. Workers	Total Investment (million US)	No. Enterprises	No. Workers	Total Investment (million US)	No. Enterprises	No. Workers	Total Investment (million US)
LEs*1	416	118,427	12,914	190	16,808	1,222	606	135,235	14,136
SMEs*2	78	2,072	40	52	1,158	30	130	3,230	70
Total	494	120,439	12,954	242	17,966	1,252	736	138,465	14,206

Source: SUFRAMA
Note: *1: LEs: Large enterprises (Part 1 of the SUFRAMA factory list, see Main report 3.3.3)
*2: SMEs: Small and medium enterprises (Part 2 of the SUFRAMA factory list, see Main report 3.3.3)

Most of the industry located in the MFZ is: manufacturing electro-electronic and communication appliances, machinery, metallurgy, chemical, plastics, and transport machinery.

c.4 Industrial Production and Trade in the SUFRAMA Area

Industrial production value in the Manaus Free Trade Zone has increased 31% over the past five years (2004 to 2008) to R$ 54.4 million (US$29.4 million). Within the zone, the largest contributors to this are electro-electronics, two-wheel production (motorbikes and bicycles), and chemical industries, which in 2008 were 65% of the total industrial production value.



Source: SUFRAMA

Figure 2-3: Changes in Industrial Production Value in PIM/MFZ (2004-2008)

The following table shows the trade balance of the Industrial Pole of Manaus (PIM) in terms of overseas and domestic markets. Although the MFZ recorded a trade deficit for the overseas market, it gained enough trade surpluses in the domestic market to gain net trade profit.

Table 2-4: Trade Balance of the Industrial Pole of Manaus (2004-2008)

(Unit: 1,000 Real)

Year	International Trade			Domestic (Interregional) Trade			Total Balance (G=C+F)
	Export (A)	Import (B)	Balance (C=A-B)	Export (D)	Import (E)	Balance (F=D-E)	
2004	3,162,613	10,984,923	-7,822,310	38,242,181	11,153,510	27,088,671	19,266,361
2005	4,922,147	11,520,976	-6,598,829	40,741,403	12,447,164	28,294,239	21,695,410
2006	3,227,608	12,871,664	-9,644,056	46,213,521	13,070,188	33,143,333	23,499,277
2007	2,017,806	12,229,762	-10,221,956	47,664,327	12,812,249	34,852,078	24,640,122
2008	2,176,119	15,602,186	-13,426,067	52,194,955	14,216,217	37,978,738	24,552,671

Source: SUFRAMA

In the MFZ, the major contributors to foreign currency earnings through overseas export are the top-ranking industries in production value: the electro-electronics, two-wheel, and chemical industries. However, the ratio of export to the total industrial production output was less than 10% for all those industries in 2008. The industries with a high percentage of product export are: the timber/lumber industry (45%) and manufacturers of articles for daily use (15%), such as lighters, pens, shavers, etc.

2.1.4 Superintendency of the Manaus Free Trade Zone (SUFRAMA)

a. Area of Supervision

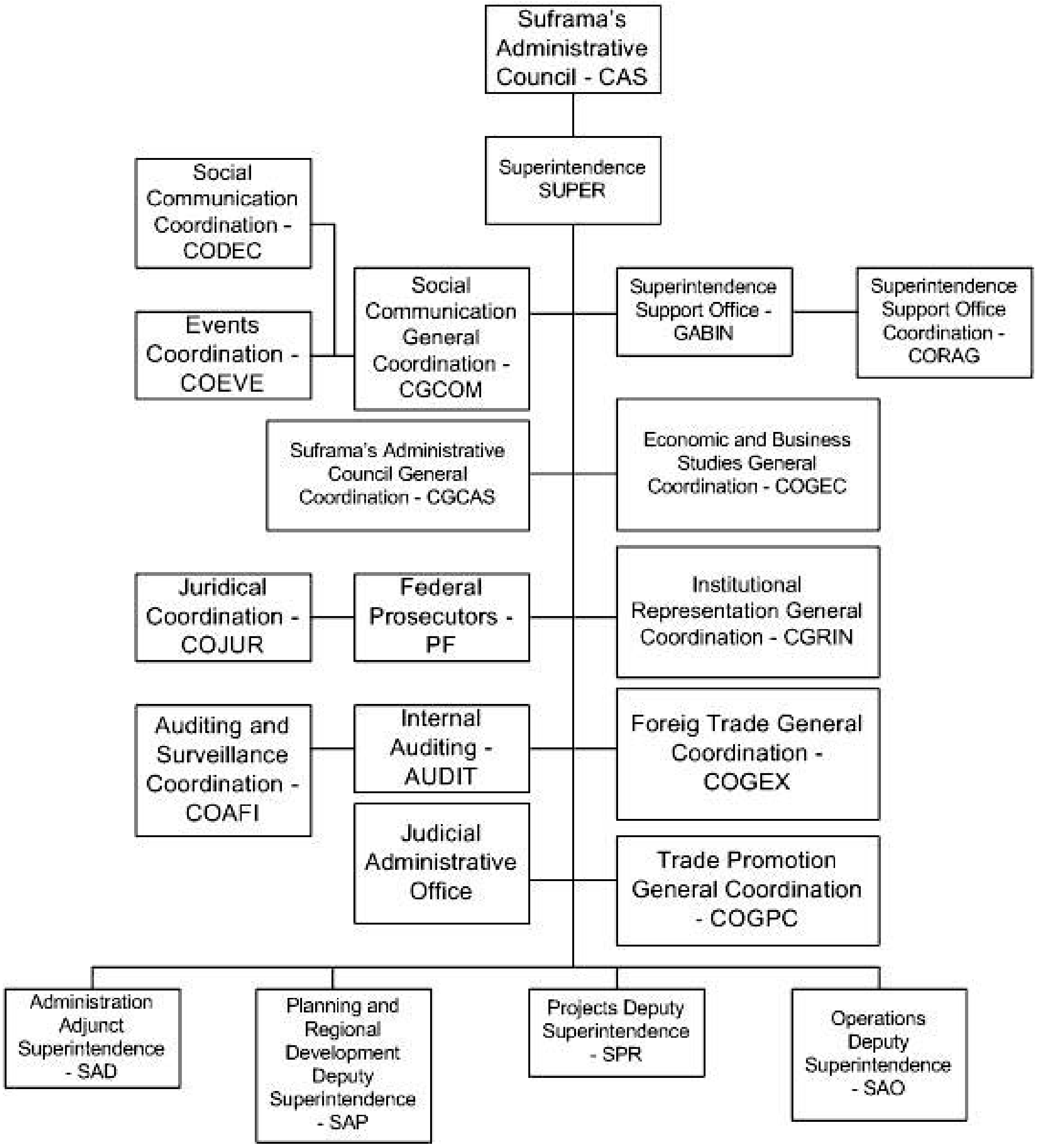
SUFRAMA is vitalizing the regional economy through creating employment opportunities and stimulating production toward socio-economic development not only in the MFZ in the State of Amazonas, but also in the other four states of the Occidental Amazon (Acre, Amapa, Rondonia, and Roraima).

b. Structure

As the figure below illustrates, there are four deputies under the Superintendent, each in charge of its own department: Administration Adjunct Superintendence (SAD), Planning and Regional Development Deputy Superintendence (SAP), Projects Deputy Superintendence (SPR), and Operations Deputy Superintendence (SAO), respectively. In addition to these four departments, there are nine coordinations and offices, such as Social Communication and Judicial Administration, directly below the Superintendent.

There was no unit at SUFRAMA in charge of industrial waste management, and therefore, the primary counterpart for this study is COGEX (Foreign Trade General Coordination)--one of the nine coordinations and offices directly under the Superintendent--which generally deals with all overseas technical cooperation and international cooperation.

However, as an output of this study, SUFRAMA has formed an Industrial Waste Management Group (IWM Group) dedicated to industrial waste management at SUFRAMA and three SUFRAMA officers have been assigned the group. As of May 2010, no decision has been made as to which department the group will be attached, however, it will be officially established within the 2010 fiscal year in order to put into effect the master plan (M/P) that has been formulated for the improvement of industrial waste management.



Source: SUFRAMA

Figure 2-4: Organizational Structure of SUFRAMA

c. Personnel

SUFRAMA has a total of 1,354 officers and workers as of 2008, of which 356 are officially hired permanent public servants. SUFRAMA also outsources 936 administration officers, security and sanitation services, and other workers. There are also 40 trainees employed at SUFRAMA. In 2008, the total personnel expenditure at SUFRAMA for the above officers and workers amounted to R$ 77.5 million.

Table 2-5: Expenditure and Number of Personnel at SUFRAMA (2008)

Description	Number of Persons	Personnel Expenditure (Real)

Public servants working in the units	356	21,869,733.95
Temporarily hired public servants	16	1,314,295.45
Outsourced workers (security guards and janitors)	273	5,362,162,.81
Outsourced administrative workers	523	46,453,864.44
Other outsourced workers	140	1,762,820.17
Trainees	40	137,298.47
Public servants borrowed from other organizations	3	238,915.77
Public servants loaned to other organizations	3	325,522.51
Total	**1,354**	**77,464,613.59**

Source: CGDER, SAP, SUFRAMA (2008)

d. Fiscal Expenditures of SUFRAMA

The fiscal expenditure of SUFRAMA for six years, from 2003 to 2008, for development of the five states of the Occidental Amazon, including MFZ, as well as stimulus of various industrial sectors, was R$ 440 million. The following tables show the allocation of fiscal expenditure for each state and by sector. The largest expenditure went toward infrastructure development, accounting for some 73% of total expenditure for that period (2003~2008).

Table 2-6: Trend of SUFRAMA's Investment in PIM Development by State (2003-2008)

Unit: 1,000 real

States	2003	2004	2005	2006	2007	2008	Total
Acre	3,147	13,543	11,295	9,500	58,129	2,220	**97,834**
Amapa	0	8,400	415	0	2,300	9,000	**20,115**
Amazonas	3,410	35,964	10,547	16,123	28,192	1,800	**96,037**
Rondonia	0	18,450	11,053	4,900	25,145	3,870	**63,418**
Roraima	1,000	11,160	10,547	0	22,425	2,800	**47,932**
Entities	12,148	19,797	17,923	3,421	56,008	5,704	**115,002**
Total	**19,704**	**107,315**	**61,782**	**33,944**	**192,200**	**25,394**	**440,339**

Source: CGDER, SAP, SUFRAMA (2008)

Table 2-7: Trend in SUFRAMA's Investment in PIM Development by Sector (2003-2008)

Unit: 1,000 real

Types	2003	2004	2005	2006	2007	2008	Total
Production	0	1,939	2,135	4,191	5,562	5,200	**18,628**
Infrastructure	7,807	88,163	43,057	18,006	150,675	14,740	**323,447**
Investment Promotion	1,382	910	1,818	281	3,525	0	**7,917**
R & D	10,485	14,008	11,465	11,114	16,057	5,454	**68,584**
Human Resources Capacity Dept.	30	2,295	3,306	352	16,381	0	**22,363**
Total	**19,704**	**107,315**	**61,782**	**33,944**	**192,200**	**25,394**	**440,339**

Source: CGDER, SAP, SUFRAMA (2008)

2.1.5 Socio-Economic Issues

It will be necessary to resolve the following issues in order to secure the future development of MFZ.

a. Acquisition of Environmental License of PIM

Although SUFRAMA has invested basic infrastructure such as roads and electricity, PIM was developed on the premise that individual enterprises are responsible for obtaining environmental licenses to develop factory sites, construct buildings, effluent treatment facilities and other environmental protection measures before entering MFZ. Thus, with the exception basic infrastructure such as roads and electricity, there is no overall development plan for PIM. Such development measures were used for both industrial districts, so that with the exception of construction plans for roadways and electrical supply facilities, PIM and the two industrial districts (DIs) were developed without the necessary environmental protection plans to conduct environmental impact assessment (EIA).Thus, in order to understand the environmental protection plan of the DIs and PIM overall, it is necessary to combine the environmental licenses obtained when individual factories were constructed. Moreover, understanding the current environmental conditions of the DIs and PIM requires that each factory plan and their actual operation conditions be surveyed and the results synthesized. Such work is extremely labor intensive and SUFRAMA cannot perform it unassisted. Rather, the bulk of such analysis must be done by IPAAM, which issues the environmental licenses and rights for operation. Nevertheless, SUFRAMA must have a firm grasp of the structure for environmental protection of PIM/MFZ if it is to promote PIM to potential investors. Even if an individual business takes the necessary precautions for environmental protection, in the case that pollution of the overall PIM area is indicated, great damage is done to that company's activities. Furthermore, SUFRAMA has the right to withhold the special tax benefits to companies pointed out by IPAAM that they do not carry out sufficient environmental protection measures.

As shown above, in order to obtain the environmental licenses for PIM, SUFRAMA and IPAAM--given their respective responsibilities--must work together to formulate an environmental protection plan for the DIs and entire PIM and conduct an environmental impact assessment (EIA). In order to carry out such work, the data and information obtained in this study will serve as an important base.

b. Changes in the Industrial Structure of MFZ

Presently, assembly production is the central activity of the PIM factories, which import parts for products largely consumed in the domestic market. Thus, the trade balance of MFZ is running at a deficit. In order to improve the situation, the Ministry for Development, Industry and Foreign Trade and SUFRAMA are working to entice the parts industry, and moreover, are considering attracting the materials industry and others to further raise the added value of the area. An increase in the parts and materials industries will provide more economic benefit to the MFZ than by reducing the trade deficit and increasing added value. On the other hand, in contrast to the assembly industry, parts and materials include a large number of processes which impact the environment, such as materials processing, surface treatment, and exhaust and effluent treatment.

It is likely that changes to the industrial structure of MFZ will bring about significant changes in accordance with production to the type and quantity of industrial waste that is generated. That is, due to the fact that packaging waste, the current primary waste, is relatively easy to recycle, one should expect higher environmental impact, difficulty in recycling, and more complicated treatment measures to arise.

c. Infrastructure Preparation

There are a number of infrastructure-related issues, as follows, in order to guarantee the future development of MFZ.

- Manaus is currently independent of the Brazilian national electricity grid, using thermal- and hydro-electric generation; however the generation cost for these is considerably higher than the national average. Presently, the federal government is providing compensation for this cost difference. Moreover, given the current power supply structure, there are frequent power outages in the dry season when power demand is high. Thus, there is a constraint apparent in introducing industries that consume a great deal of electricity, such as the materials industry.
- On-land public transportation is limited to roads, resulting in heavy traffic jams in Manaus City during the morning and evening rush times. For a large municipality with a population of over 1.7 million, dependence on a road network alone for on-land public transport indicates a significant restriction.
- Manaus City does not have a wastewater treatment facility and untreated effluent is released into the Amazon River. In order to attract tourism and sustain and improve the waterfront, a sewerage treatment facility is needed.

2.2 State of Environmental Management

2.2.1 Environmental Laws and Regulations

a. Federal Level

Environmental policy in Brazil and the current legal framework were established by the National Environmental Policy Law No. 6938/81 on 31 August 1981. With this National Environmental Policy Law, the revision of the Federal Constitution of 1988, Article 225, states that environmental conservation is the responsibility of both the government and society. Moreover, Article 23 states the joint competence of the Federal government, States and Federal Districts and Municipalities—three levels of government—to protect the environment and combat pollution. Article 24 establishes the competence of the Federal government, States and Federal Districts to jointly legislate the responsibility for damage to the environment.

The national government prepares common federal laws dealing with the environment, and based on these, each state establishes laws which are more stringent than the constitutional requirement. In addition to the National Environmental Policy Law (No. 6938/81) and the Brazilian Federal Constitution (1988), already mentioned, the major federal laws are:

- Environmental Crimes and Administrative Sanctions Act (Law No. 9605/98)
- Administrative Liability Act (Decree No. 3179/99)

b. State Level (Amazonas)

The main environmental management laws of the State of Amazonas are as follows:

- Amazonas State Constitution—chapter 11—Environment

- Fundamental State Environment Law (Law n. 1,532/82): State Policy for the Prevention and Control of Pollution, Improvement and Recovery of the Environment and Protection of the Natural Resources
- Decree n. 10,028/87: On the State Licensing System of Activities with Potential Environmental Impact and Application of Penalties and other Measures
- Law n. 2.513/98: Obligation for the registration of companies responsible for the transportation of hazardous cargoes or products in the State Environmental Organization
- Ordinance n. 1/2004: Environmental Licensing for Waste Generation Sources
- Law n. 3,135/07: Climate Change State Policy, Environmental Conservation and Sustainable Development of the State of Amazonas
- Law n. 1991, August 21, 2007: Establishes the National Policy on Solid Wastes and other Measures

c. Municipal Level (Manaus)

The main environmental management laws of Manaus City are as follows:

- Organizational Law of the Municipality of Manaus
- Law n. 605, 24 July 2001: environmental code of the municipality of Manaus
- Law n. 671, November 4, 2002: Regulates the Master and Environmental Plan, Establishes Guidelines for the Development of the City and other matters relating to Planning and Management in the Municipality

2.2.2 Environmental Organizations

a. National System of Environment

The National System of Environment (SISNAMA) is based on the National Environmental Policy Law and acts as the framework for implementing policy and regulation related to the environment in Brazil. The SISNAMA system is composed of the Ministry of Environment (MMA), National Council for Environment (CONAMA), Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), and other environmental federal, state and municipal agencies which cooperate and complement each other to implement the national environment program.

b. Federal Level

Since Brazil is a federal republic, it has independent environmental organizations at the federal, state and municipal government levels which function to complement and cooperate with each other.

The following table summarizes the federal government organizations which establish and enforce environment related laws at the national level. A branch of the federal environment ministry exists in each state, which is responsible to implement environmental regulation according to federally established environmental policy guidelines and in charge of environmental concerns which are outside federal jurisdiction.

Table 2-8: Summary of Federal Organizations related with Environmental Management

Organization	Description
MMA: Ministry of Environment	An environmental agency was established in 1990 which in 1992 became the Ministry of Environment, the central federal organization dealing with the environment. Responsible for the formulation of environmental policy and guidelines at the national level. Similarly, it carries out planning, coordination and monitoring of national environmental policy. The Ministry of Environment (MMA) is composed of 5 secretariats at present: (1) Secretariat of Climate Change and Environmental Quality, (2) Secretariat of Biodiversity and Forests, (3) Secretariat of Water Resources and Urban Environment, (4) Secretariat of Extractivism and Sustainable Rural Development, and (5) Secretariat of Institutional Coordination and Environmental Citizenship. Also, related organizations are: (1) National Council for Environment (CONAMA), (2) National Council for Legal Amazon (CONAMAZ), (3) National Council for Water Resources, (4) Deliberative Council for the National Environment Fund, (5) Genetic Heritage Management Council, and others.
IBAMA: Brazilian Institute for the Environment and Renewable Natural Resources	Established as a combination of four organizations in 1989—SEMA (the Special Secretariat of the Environment), SUDHEVEA (Superintendency of Rubber Development), SUDEPE (Superintendency of Fisheries Development), and IBDF (Brazilian Institute of Forestry Development)—responsible for the inspection and approval of environmental assessments and such, as well as the enforcement of environment related federal policy and regulation. With 6800 employees, offices are located throughout the country, but it does not deal with environmental administration at the state level.
CONAMA: National Council for the Environment	The paramount organization for national environment policy, established in 1981, which deals with the formulation of federal environmental standards. The council is made up of 108 members, presided over by the Environment Ministry and its Executive Secretariat is managed by the Environment Minister Executive Secretary. CONAMA examines environmental standards, guidelines and laws and issues resolutions therein.
Public Attorneys' Office	In charge of the investigation and prosecution of civil and criminal cases dealing with the rectification or compensation for environmental pollution.
Environment Police Precincts	Works in parallel with the Public Attorneys' Office and cooperates to investigate environmental crimes.

c. Amazonas State

The following table summarizes the State government organizations which establish and enforce environment related laws of the State of Amazonas.

Table 2-9: Summary of Amazonas State Organizations related with Environmental Management

Organization	Description
SDS: Secretariat for Environment and Sustainable Development	The central Amazonian State organization, dealing with environment, is responsible for the formulation and managing the execution of environmental policy and conservation planning at the State level. The Secretariat has four Deputy Executive Secretariats, each of whom governs one of four departments. The Department of Geographic Diversity and Water Sources is in charge of the State's waste management policy. There are also five Autonomous Entities, of which IPAAM is one. This organization structure is shown in the Figure 2-5.
IPAAM: Institute of Environmental Protection of the State of Amazon	The organization which enforces environmental policy in the State of Amazonas, established in 1995 after the reorganization of IMA/AM (The Amazonas State Environmental Protection and Natural Resources Development Institute (est. 1989)). The major environmental administrative powers of IPAAM are environmental licensing approval, environmental monitoring and inspection. Its mission is to enforce environmental policy for the sustainable development of the State of Amazonas. The director is supported by a management department, technical department and law department, with a total of 183 employees, of which 59 are engineers in charge of actual operations. IPAAM carries out all factory management affairs, from monitoring to environmental licensing to on-site inspections. There are 6 technical staff in the industrial licensing department in charge of issuing licenses. The organizational structure is shown in the Figure 2-6.
Regional Public Attorneys' Office for the State of Amazonas	In charge of the investigation and prosecution of civil and criminal cases dealing with the rectification or compensation for environmental pollution. The Environmental and Cultural Assets Department is also the unit which specializes in environmental affairs.
Amazonas State Environmental Police	Works in parallel with the Public Attorneys' Office and cooperates to investigate environmental crimes.

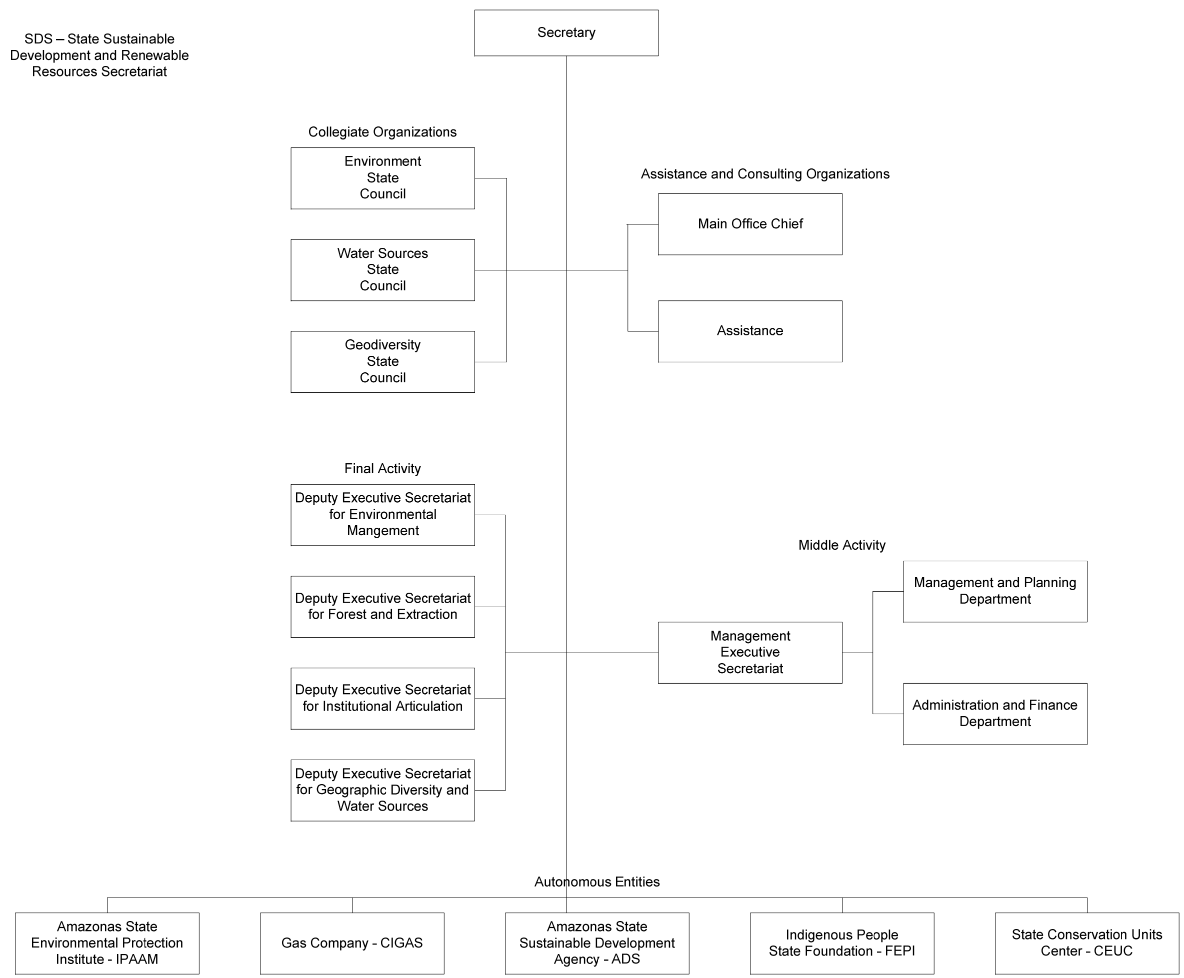


Figure 2-5: Organization Chart of SDS

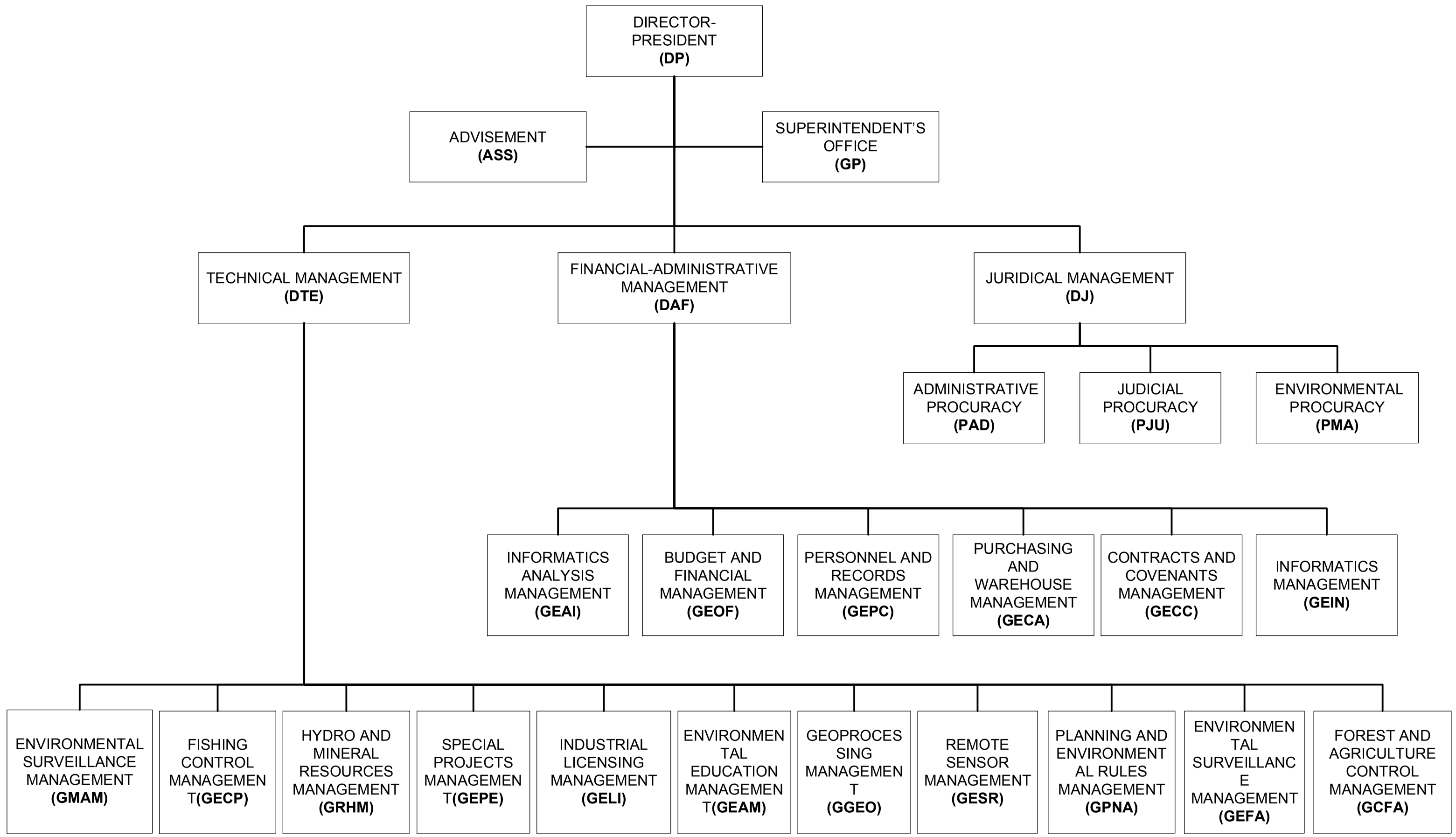


Figure 2-6: Organization Chart of IPAAM

d. Manaus City

The following table summarizes the municipal government organizations which establish and enforce the environment related laws of Manaus City.

Table 2-10: Summary of Manaus City Organizations related with Environmental Management

Organization	Description
SEMMA: Municipal Secretariat of the Environment	SEMMA was established in 1989, and restructured in April 2006, to carry out the environmental regulations of Manaus City. There are 323 employees with an additional 195 interns. There are four departments: Land Management Department, Environmental Quality Management Department, Plant and Afforestation Department, and Environmental Preservation Zones Department. The Environmental Quality Management Department is monitoring factories, but it is unclear how this task is shared with IPAAM. Basically, this department has been handling small factories within the municipality.
SEMULSP: Municipal Secretariat of Urban Cleaning and Public Services	SEMULSP is in charge of waste management and cleaning services of Manaus City. There are 2100 employees, in addition to 1200 staff outsourced from an agency. The operating budget for the 2006 fiscal year was R$ 75 million.

2.2.3 Environmental Licensing System

a. Environmental Impact Assessment and Environmental License System

The Environmental Impact Assessment (EIA) system in Brazil is included in the procedures to obtain an environmental license. The inclusion of EIA in the procedures to obtain an environmental license is true for the State of Amazonas and other States in Brazil as well.

b. Environmental Licensing System at the Federal Level

There are three environmental licenses that a proponent must acquire when conducting a project, starting with the Previous License (PL) from the planning stage to the implementation stage, and then an Installation License (IL) and Operation License (OL), according to the provisions put forth in CONAMA Resolutions 01/86 and 237/97. CONAMA Resolution 237/97 provides a summary of each license and the effective period of validity. In cases where state regulations differ from the said resolution, the state regulation takes precedent.

Table 2-11: CONAMA Resolution 237/97 Environmental Licenses Description and Validity

Environmental License	Description	Period of Validity
Previous License (PL)	Granted in the planning phase of the enterprise or activity, approving its location and conception. It is not possible to start construction with the PL; must clear the PL requirements and then obtain an installation license (IL)	5 years
Installation License (IL)	Authorizes the installation of an enterprise or activity according to the specifications of the approved plans, programs and projects, including the environmental control measures and other conditions, of which new determinations are constituted	6 years

Operation License (OL)	Authorizes the operation of the activity or enterprise after the verification of the effective fulfillment of the content of prior licenses, with the environmental control measures and conditions determined for the operation	4~10 years

CONAMA Resolution 237/97, Article 10 states, "to start the process in accordance with the required license, upon discussion with the proponent, the environmental monitoring body (IBAMA, State, Municipal environmental agency) will determine the forms, environmental plans and environmental studies required. Based on this same resolution, the proponent will meet with the relevant environmental monitoring body at the first stage in acquiring an environmental license.

Through this preliminary discussion, the governing body will determine the environmental license needed for the project[1], and may determine that the project is partially exempt from the process, when deciding the type of license (PL, IL, OL) required.

c. Environmental Licensing System in Amazonas State

c.1 Industrial Activities which require Environmental License

Environmental licensing in the State of Amazonas was established by the first State environmental law No. 1532 of 6 July 1982. The details are given in Regulation No 10028. According to Law No.1532, stipulates that CODEAMA (The Center for Development, Research and Technology of the State of Amazonas) will issue environmental licenses in Amazonas State, but CODEAMA was abolished and now the rights for this were transferred to IPAAM. Provisions in Act 8 state that industrial activities, as shown below, that could potentially impact the environment require an environmental license[2].

- Mineral excavation, treatment
- Tree harvesting
- Agriculture, cattle breeding
- Hunting, fisheries
- Manufacturing
- Engineering, construction, land creation/zoning
- Collection, storage, treatment and final disposal of products, raw materials and wastes
- Infrastructure (dams, airports, ports, roads, etc.)
- Hospitals, clinics, laboratories
- Activities with commercial- or service-oriented use of fuel (solid/liquid/gaseous)
- Incineration of waste or materials
- Activities that change igarape and other aquatic ecology
- Use or stowage of agrochemicals
- Activities with potential environmental impact to landscape or nature

[1] The governing body may take into consideration the details and scale of a given project, as stipulated in Federal Law 7,804/90 and CONAMA Resolution 237/97, and alter the requirements at the preliminary discussion stage.

[2] Decree No 10028 of February 1987

- Activities with potential environmental impact to cultural assets, historical artifacts, etc.
- Activities IPAAM deems may have potential impact to the environment

As shown above, most industrial activities require a license. These activities are divided into categories according to 32 codes, and further into sub-category codes. The following table shows the major classification codes of activities with potential environmental impact under which are the detailed classification codes.

Table 2-12: Major classification code of activities with possibility of environmental impact

Code	Activities with potential environmental impact	Code	Activities with potential environmental impact
01∗∗	Extraction and treatment of minerals	17∗∗	Clothing, shoes, fabric and leather items manufacturing
02∗∗	Non-metallic material and product manufacturing	18∗∗	Food manufacturing
03∗∗	Metallurgy (ferrous, nonferrous)	19∗∗	Beverage production
04∗∗	Mechanical products manufacturing	20∗∗	Tobacco manufacturing
05∗∗	Electric & electronic products manufacturing	21∗∗	Printing
06∗∗	Transport machine manufacturing	22∗∗	Commerce and services
07∗∗	Lumber & wood product manufacturing	23∗∗	Construction and infrastructure
08∗∗	Furniture manufacturing	24∗∗	Auxiliary services including provision of electricity and water
09∗∗	Paper and cardboard manufacturing	25∗∗	Wholesale
10∗∗	Rubber manufacturing	26∗∗	Transportation and terminals
11∗∗	Leather products manufacturing	27∗∗	Economic and domestic activities services
12∗∗	Chemical product manufacturing	28∗∗	Medical and veterinary services including laboratory
13∗∗	Pharmaceutical products manufacturing	29∗∗	Stock-breeding, fishing and water-farming and vivariums and wild fauna stewardships
14∗∗	Perfume, soaps and candles manufacturing	30∗∗	Waste treatment and recycle
15∗∗	Plastic material and product manufacturing	31∗∗	Components and electronic devices manufacturing
16∗∗	Textile product manufacturing	32∗∗	Vegetable oil extraction

Source: Classification of pollution sources IN 001/06, published on 3/12/2007

c.2 Environmental Licenses related to Waste Management

The following table shows detailed codes in terms of waste management.

Table 2-13: Detailed code of activities with potential environmental impact related to waste management

Code	Activities with potential environmental impact（major classification）	Code	Activities with potential environmental impact（detailed classification）	
				Impact
22＊＊	Commerce and services	2217	Incineration service	Large
		2218	Co-Processing service of waste	Large
		2219	Collection center of pesticides	Medium
24＊＊	Auxiliary services including provision of electricity and water	2407	Collection and/or treatment of industrial solid wastes	Large
		2408	Final destination of municipality wastes	Large
		2410	Collection and transportation of inert solid wastes	Micro
		2411	Collection and/or storage and/or commercialization of sold wastes	Medium
		2412	Collection and/or treatment of industrial hazardous liquid wastes	Large
		2417	Disposal of industrial waste in landfill	Large
26＊＊	Transportation and terminals	2615	Transportation and storage of industrial hazardous solid wastes	Large
30＊＊	Waste treatment	3001	Treatment of solid industrial waste without chemicals	Medium
		3002	Treatment of liquid industrial waste	Medium
		3003	Treatment and solid industrial waste with chemicals	Large
		3004	Treatment of pallet	Medium
		3005	Recycle of paper and cardboard	Medium
		3006	Treatment of mineral wastes (Re-processing of wastes)	Medium

Source: Classification of pollution sources IN 001/06, published on 3/12/2007

Only recently has the reuse and recycling of wastes become prevalent in the state of Amazonas, and thus the only codes which have been set are for recycling paper and cardboard. According to the survey of waste service companies, the following codes are also used for the environmental license of companies engaged in reuse and recycling activities. As stated above, the current environmental licensing code system in terms of waste management does not identify all the waste service companies and improvement is needed in some areas.

Table 2-14: Major classification code of activities with possibility of environmental impact

Code	Activities with potential environmental impact（major classification）	Code	Activities with potential environmental impact（detailed classification）	
				Impact
02＊＊	Production of non-metal products and material	0213	Production of tile, block and other material	Medium
03＊＊	Smelting (Iron and steel making, non-ferrous	0301	Production of iron by reduction of iron ores (iron making)	Large

	metal production)	0315	Production of non-ferrous metal by primary smelting (non-ferrous metal smelting)	Large
		0326	Production of solder and other materials	Medium
07＊＊	Manufacturing wooden products	0711	Manufacturing of wooden products for home and industrial use	Small
09＊＊	Manufacturing of paper and cardboard product	0903	Manufacturing of general paper products	Large
15＊＊	Manufacturing of plastics product	1502	Manufacturing of industrial plastic products	Medium
		1503	Manufacturing of plastic products for home and individual use	Medium
		1505	Manufacturing of plastic products for package and printing use	Medium
		1506	Manufacturing of plastic pipes, tubes and connecting parts	Medium
		1507	Manufacturing of several types of plastic products	Medium

c.3 License Types and Fulfillment of Conditions

There are three types of environmental licenses, as shown below. Business activities require three types of license be obtained.

1. Previous License (PL): Granted at the preliminary stage of the enterprise or activity. It is granted for up to one year, after which the license must be reissued. In order to obtain the PL license, the place and activity must be approved in accordance with local government guidelines.
2. Installation License (IL): Authorizes the construction of a factory and installation of a facility, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.
3. Operation License (OL): Authorizes the operation of the activity or enterprise, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.

c.4 Documents Required for Waste Management

The required documents and conditions are given in articles No.10 to No.13 of "Regulation No 10028. According to Lei No.1532"; these documents and conditions vary according to the particular activities. The following table shows the necessary documents and conditions in the case of storage, treatment and final disposal of wastes.

Table 2-15: Environmental Licensing Documents necessary for Storage, Treatment and Final Disposal of Wastes

Type of License	No	Type (B/C*)	Requirements
Previous License	1	B	Application for SELAPI and Previous License (IPAAM Form)
	2	B	Payment receipt of administration fee (IPAAM Form)
	3	B	Company contract or similar document in case of juridical person

	4	B	Copy of ID (identification) and CPF (registration) of the legal representative
	5	B	Permit by the Municipality informing that proposed location and activity are in accordance with the Municipal guidelines
	6	B	Certificate of possession of property sent by SUFRAMA, incase that the property is located in industrial district
	7	B	Certificate of possession of property, in case that the property is located in rural area
	8	B	Certificate of registration of land, plant and building
	9	B	Location map of the enterprise
	10	B	Report of process of the activity development which is signed by the responsible person of the company
	11	B	Location, installation floor plans of the facilities
	12	C	Environmental studies
	13	C	Others (specify)
Installation License	14	B	Application of installation license (IPAAM Form)
	15	B	Payment receipt of administration fee (IPAAM Form)
	16	B	Registration of activities: sanitary and industrial landfill (IPAAM form)
	17	B	Debts Clearance Certificate issue by Ministry of Finance of Amazonas, in case of enterprise
	18	B	Details of storage, treatment and final disposal including monitoring points
	19	B	Project plan approved by competent authority
	20	B	Detail drawing of installation of facilities and plants, including effluent discharge and exhaust gas emission points.
	21	B	Domestic and industrial wastewater treatment system approved by competent authority
	22	B	Preliminary license which satisfied all the requirement and restriction clauses
	23	C	Others (specify)
Operational License	24	B	Application of operation license (IPAAM Form)
	25	B	Payment receipt of administration fee (IPAAM Form)
	26	B	Registration of activities: storage, transportation of products and waste (IPAAM form)
	27	B	Previous License and Installation License which satisfied all the requirement and restriction clauses
	28	C	Others (specify)

Note: B: Basic requirement, C; Complementary requirement

Source: IPAAM homepage

The environmental studies necessary for the Previous License (item No 12) are simple compare to environmental impact previous studies (EPIA). Those who apply for an environmental license for activities of storage, treatment and final disposal of waste submit the documents from No 14 to No 23. Then, when IPAAM determines an EPIA is necessary, they must carry this out and submit it to IPAAM. A summary report of EPIA is an environmental impact report (Relatorio de Impacto Ambiental, RIMA). The RIMA is shown to the public, for example, on the IPAAM website. An EPIA is a detailed and lengthy report which includes all the data of the studies, whereas, on the other hand, the RIMA report will total approximately one hundred pages. In the case of the hazardous industrial waste landfill project in Manaus, IPAAM judged that an EPIA was necessary, which was conducted, and the RIMA made available at the IPAAM website.

d. Environmental License Fee in Amazonas State

Normative Instructions 01/06 and 01/07 of IPAAM were substituted by Law no. 3219 of 28/12/2007, which regulates the granting of environmental licenses in the State of Amazonas and other measures. Through this law, the Government of Amazonas State establishes Environmental Licensing Fees in the State of Amazonas. Individuals or legal entities performing activities should pay environmental licensing fees to IPAAM. Only the State Executive Bodies and Agencies are exempt from environmental licensing fees.

The following activities are subject to PL: construction, installation, expansion, enlargement, alteration, rehabilitation, operation and operation of polluting activities, users of environmental resources, and companies that cause environmental degradation.

IPAAM provides basic criteria, by which studies will be required environmental impact assessment for environmental licensing, subject to federal and state laws. The Environmental Impact Assessment (EIA) will be prepared by qualified technicians; the costs shall be borne by the project proponent. The environmental impact assessment and other studies will be accessible to the public. The activities mentioned in this article that do not comply with environmental regulations will be sanctioned according to provisions of Law 1532 of 6 July 1982 and Decree No. 10028, of 4 February 1987.

The environmental licensing fees, subject to the provisions of Decree 10,028, of 4 February 1987 are as follows:

1) Previous License fee;

2) Installation License fee;

3) Operation License fee.

Exempt from environmental licensing fee in the State of Amazonas, are nonprofit associations operating in the field of solid waste recycling or committed to reducing pollution. The amounts of the prescribed fees for licensing can be charged in proportion to the duration of the environmental license.

e. Role of IPAAM

IPAAM may prosecute a polluter that has obtained an environmental license in the case of illegal activity. When IPAAM issues the environmental license, they check the application forms and the site. Also, when the licenses are renewed after one or two years, they monitor by checking the forms and site. Moreover, should there be protest or reports from residents of the surrounding area, IPAAM may carry out a check even during the license period, and if there is any illegal activity found, may revoke the license or impose a fine.

According to the 2008 Annual Report of IPAAM, there were 2,806 licenses (new and renewals) for 2008, of which 1,041 were for the rural area outside of city boundaries and 1,765 within city boundaries. According to issue, about 70% were related to PIM and municipal (Brown Issue), 413 were related to aqua farming, aquatic or mineral resources (Blue Issue), and 436 were for forestry resources and agriculture (Green Issue). Furthermore, 44% of the licenses were for 861 projects within PIM. IPAAM earns 6 to 7 million Real (Brazil currency) for the issuance and renewal of environmental licenses.

2.2.4 Environmental Impact Assessment (EIA) System[1]

a. EIA-related Laws and Ordinances at the Federal Level

The environmental impact assessment (EIA) system in Brazil was introduced with the Basic Environmental Law (Federal Law n. 6,938/81). The CONAMA Resolution 01/86 (1986) and CONAMA Resolution 237/97 (1997) define the detailed provisions for EIA requirements, evaluation and approval process. The following table presents major laws and ordinances related to the EIA system in Brazil.

Table 2-16: Major Laws and Ordinances related to the EIA System in Brazil

Regulation	Year Enacted	Description
1. Federal Constitution, Art. 225	1988	Ch 1, Art 225 concerning the environment, establishes guidelines for environmental conservation and protection of natural resources.
2. Federal Law		
2.1 Basic Environmental Law (n. 6,938/81)	1981	Prescribes national policy on environment, introducing environmental licensing system and the EIA system
2.2 Environmental Crimes Law (n. 9605/98)	1998	Provides a definition for environmental crime, the law rearranges violations and penal provision sections of the environment law.
3. CONAMA Resolutions		
3.1 CONAMA Resolution 01/86	1986	Contains an important provision which provides an overview of the environmental assessment system
3.2 CONAMA Resolution 06/86	1986	Provision of guidelines and forms to obtain environmental licenses
3.3 CONAMA Resolution 09/87	1987	Provision for involvement of private citizens and public consultation in the EIA process
3.4 CONAMA Resolution 237/97	1997	Revision of the environmental licensing system and EIA guidelines

b. Laws and Regulation pertaining to EIA in Amazonas State

Similar to other states in Brazil, in Amazonas State EIA is included in the process to obtain environmental licensing. The major laws and regulations in Amazonas State pertaining to environmental licenses and the EIA system are given below.

Table 2-17: Major Laws and Ordinances related to the EIA System in Amazonas State

Regulation	Year Enacted	Description
1. State Basic Environmental Law (n. 1,532/82)	1982	Provision for basic policy of Amazonas State related to pollution control and management, environmental improvement and restoration, and natural resource conservation
2. State Environmental	1987	Provision for the license system in Amazonas State pertaining to activities which have potential impact on the

[1] This paragraph contains reference to the following, particularly in regards to federal regulations: “Report on Trade Protections of OECD Member Countries Concerning Environmental Problems Part II Environmental Regulations in Implementing Countries, February 2007, Global Environmental Forum

License Decree (n. 10,028/87)		environment

c. Requisites for Projects which require EIA

In Brazil, there is some difference in the projects which require EIA at the federal and state levels. Also, there is no standardized or uniform system between the two since the requirements (EIA/RIMA, EAS/RAS, AR, etc) vary greatly depending on the jurisdiction of the body overseeing the environmental licensing process.

When a proponent applies for an environmental license, IPAAM in Amazonas requires that an environmental impact assessment (EIA), simplified environmental study (EAS) or Risk Assessment (AR) is conducted, depending on the environmental impact of the project. After conducting EIA or EAS, the proponent must submit an Environmental Impact Report (RIMA) or Simplified Environmental Report (RAS), respectively, in order to obtain a license.

d. Projects which require EIA

d.1 The Federal Level

The projects which require EIA at the federal level are listed in the table below. These projects are listed in CONAMA Resolutions 01/86 and 05/87. However, a provision in CONAMA Resolution 237/97, Article 10, states that a business operator and the environmental agency will discuss the necessity of conducting EIA at a preliminary stage, so it is possible that the environmental agency could require EIA for projects other than those shown in the table below.

Table 2-18: Projects which require EIA at the Federal Level

Sector	Activity
Roads	Two-lane or above
Railways	
Ports	Mineral, petroleum and chemical products ports and terminals
Airports	Airports
Pipelines	Oil-pipelines, gas-pipelines, mine-ducts, sewerage systems
Power Transmission	Power transmission lines over 230KV
Hydraulic Works	Development of hydraulic works (hydroelectric dam of 10MW or greater, portable waters, irrigation, opening of ship passages, water source rectification, dredging rifts and estuaries, conversion of basins, embankments, etc;)
Fossil Fuel Extraction	petroleum, coal, etc
Mineral Extraction	
Waste	Sanitary landfills, processing and final destination of toxic or hazardous wastes
Power Plants	Primary energy source; 10MW or greater
Factories	Industrial and agro-industrial facilities (petro-chemicals, metallurgical, chlorine chemicals, alcohol distilleries, coal, extraction and cultivation of water sources)
Industrial Districts	Industrial districts and zones
Lumber	Forest stewardship activities, economic exploration of wood or

	firewood, in areas larger or smaller than 100 hectares, when it reaches significant areas in percentage terms or important from the environmental point of view.
Urban Projects	Above 100 hectares or in smaller areas holding relevant environmental interest, at the discretion of SEMA and competent municipal and state organizations;
Fuel	Any activity which uses or produces wood coal, in amount of 10 tons a day or greater
Agriculture	Agriculture or dairy projects 1,000 hectares or greater, or less when significant from the environmental point of view.
Archeological Sites	Projects with potential environmental impact in areas with ruins or relics

d.2 Amazonas State

The projects which require EIA in Amazonas State are listed in the table below. Those projects are defined in Decree No. 10,028/87.

Table 2-19: Projects which Require EIA at the State Level

No.	Activity
I	Roads
II	Railways
III	Mineral, petroleum and chemical products ports and terminals
IV	Airports, as defined by incise 1, article 48, of Law-Decree n. 32, of 18.11.66
V	Oil-pipelines, gas-pipelines, mine-ducts, collecting trunks and wastewater discharging systems
VI	Power transmission lines over 230KV
VII	Hydraulic works for the exploration of hydro resources such as: dam for hydroelectric, sanitation or irrigation purposes, opening of channels for navigation, drainage and irrigation, rectification of water sources, opening of bedsteads and passages, conversion of basins, embankments;
VIII	Extraction of fossil fuel (petroleum, schist, coal)
IX	Minerals extraction, including Class II, defined in the Mining Code;
X	Sanitary landfills, processing and final destination of toxic or hazardous wastes
XI	Power plants, any primary energy source
XII	Industrial and agro-industrial facilities (petro-chemicals, metallurgical, chlorine chemicals, alcohol distilleries, coal, extraction and cultivation of water sources)
XIII	Industrial districts and strictly industrial zones - ZEI
XIV	Forest stewardship activities, economic exploration of wood or firewood, in areas larger or smaller than 100 hectares, when it reaches significant areas in percentage terms or important from the environmental point of view.
XV	Urban projects, above 100 hectares or in smaller areas holding relevant environmental interest, at the discretion of SEMA and competent municipal and state organizations;
XVI	Any activity which uses or produces vegetable coal, in amount superior to two tons a day

e. EIA Approval Procedures

e.1 Federal Level

Once the required environmental licenses are determined, the required studies are decided, such as EIA/RIMA, EAS/RAS and so on. Basically, for projects that require EIA are those given in CONAMA Resolutions 01/86 and 05/87, but as stated in CONAMA Resolution 237/97, Article 10, the governing body has the authority to stipulate the required studies and reports, so that body will determine the type of reporting required. The process to acquire an environmental license is stipulated in CONAMA Resolution 237/97, Article 10. This process is shown in the flowchart below.

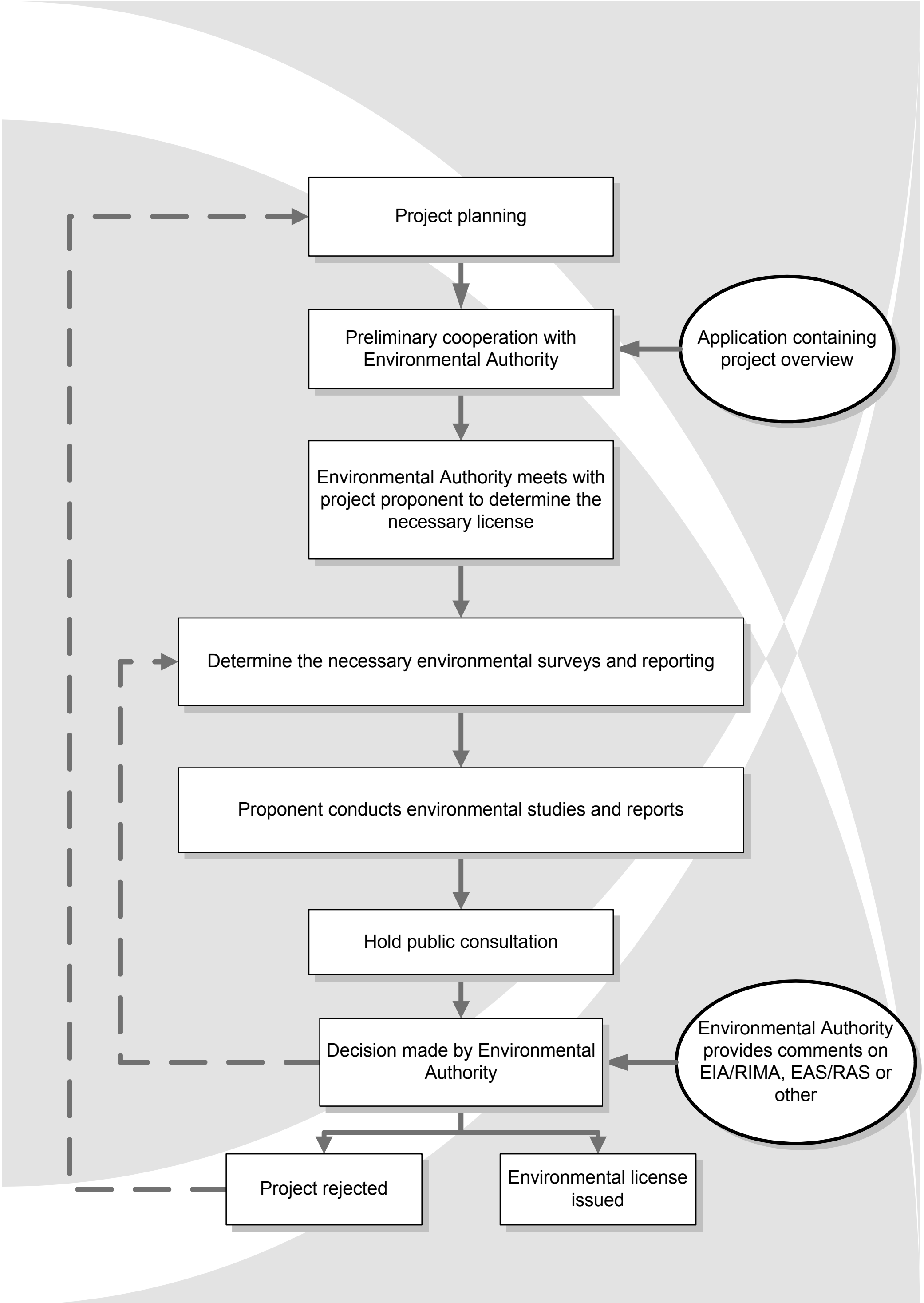
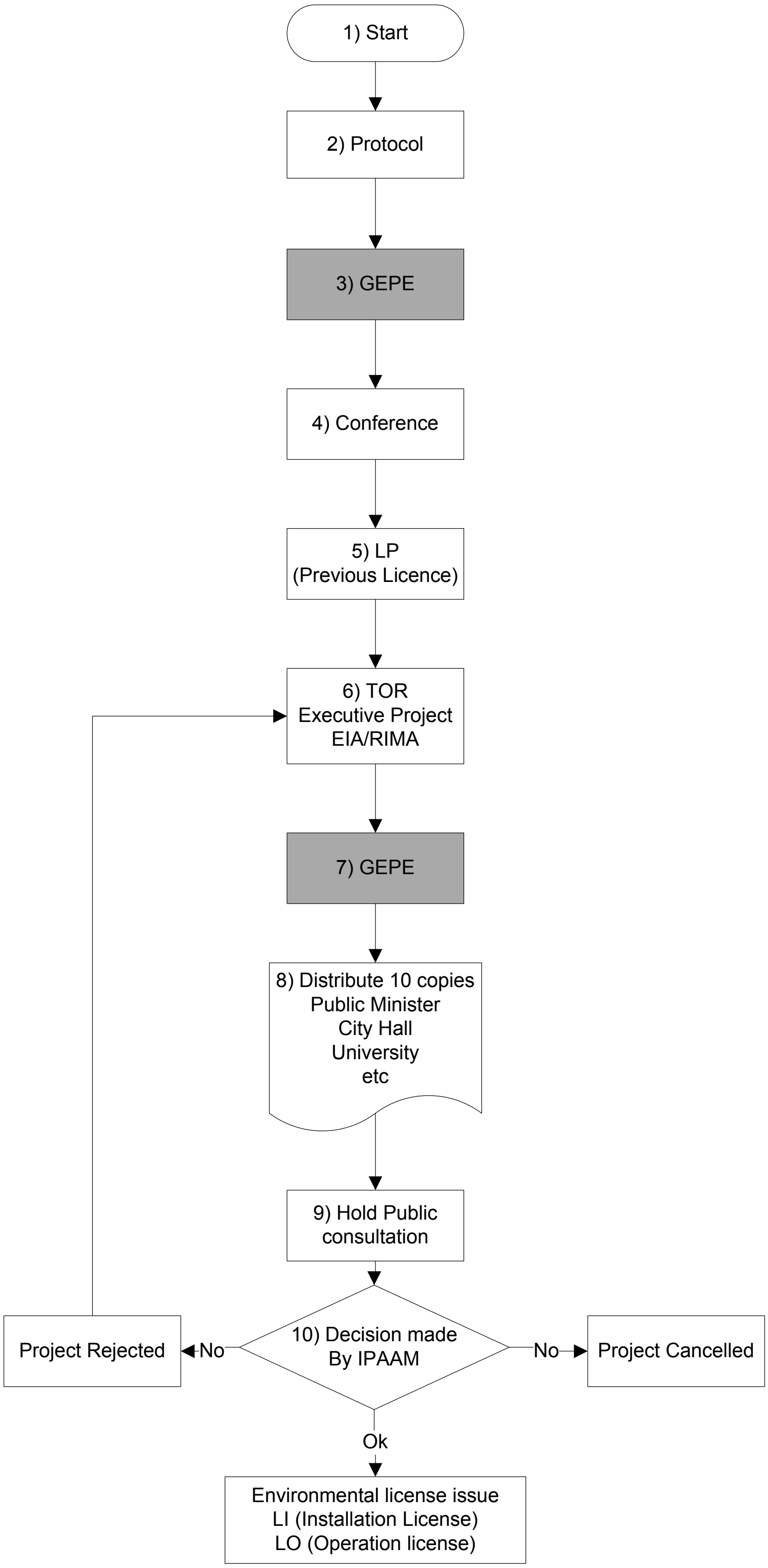


Figure 2-7: Flowchart showing Acquisition of Environmental License in Federal Level

e.2 Amazonas State

The environmental licensing system of Amazonas State significantly differs from it of Federal level in the period of validity of each license. It is much shorter than the federal one and the periods of validity of Previous License (PL), Installation License (IL) and Operation License (OL) are one, two and two respectively.

The process of EIA and acquisition of environmental license is shown in the flowchart below.



Abbreviations:

GEPE - SPECIAL PROJECTS MANAGEMENT

RIMA – Summary report of Project for Public consultation

Figure 2-8: Flowchart showing EIA and Acquisition of Environmental License in Amazonas State

f. Publication of EIA Report

Release of project data and EIA reporting is stipulated in CONAMA Resolution 09/87, which states, "IBAMA will issue the previous license after the EIA/RIMA is published in the official daily gazette or newspaper for 30 days, should there be no comment from local residents."

The process of public announcement of the EIA report and each environmental study report is also the same in Amazonas State.

g. EIA Public Consultation

Public consultation for a project is stipulated in CONAMA Resolution 09/87 as follows:

The proponent will hold public consultation concerning the impact of the project before the EIA is concluded

To hold a public consultation, it will be implemented upon application by a public organization, agency or body of 50 members or greater.

In the event public comment is offered, IBAMA will hold a public consultation after the disclosure period is over, after the 15th day, and append the PL with advisory based on the results of the discussion.

The procedures for the public consultation conducted by IBAMA (federal) or IPAAM (Amazonas State) are the same as contained in the CONAMA Resolutions.

In Amazonas State, there is no additional legislation to address this issue.

The public participation is set in the environmental licensing process with the objective of:

- Guaranteeing the divulgation of information about the projects to be licensed, specially about the possible risks towards the environmental quality of the influence areas of the project or activity and the mitigating measures meant to reduce such effects;
- Collect the expectations and concerns of the affected populations and allow the managing organization to collect the manifestations and interests of different social groups.

IPAAM, when determining the accomplishment of the Environmental Impact Study and presentation of the RIMA, will set the period to receive the comments to be made by the public organizations and other interested stakeholders and, whenever it is judged as necessary, it will promote the celebration of public information meetings on the project, the impact and discussion of the RIMA.

h. Relevant Agencies and Organizations (Application Structure)

The body that will inspect and approve the environmental license, based on the scale, sector and potential environmental impact of the project, will be the federal (IBAMA), state or municipal agency.

The body responsible for EIA is stipulated in the corresponding sections of Federal Law 7,804/90 and CONAMA Resolution 237/97 as shown in the following table.

Table 2-20: Stipulation of Organizations responsible for EIA

Related Orgs	Projects targeted for Review and Approval
IBAMA	• A project located in any of the following: (1) both Brazil and neighboring countries, (2) within Brazil's territorial waters, (3) within the continental shelf or special economic zone, (4) within a Indio reservation or federal conservation area. • A project is located in two or more states. • Environmental impact of a project affects outside of Brazil or out of State. • A project is related to research, development, production, processing, transportation, storage of radioactive material, or is intended for the application/utilization of nuclear energy (in such cases, it is necessary to seek advice from the Brazilian National Commission for Nuclear Energy (CNEN)) • A project that has been considered for application to military base construction or military use (in such cases, it must in principal comply with special military regulation)
State Organizations	• A project that takes place in one state • A project that takes place in two or more municipalities (including villages and towns), or in an area under federal protection • A project that takes place in a forest designated under Law 4,771/ 65 or other related ordinance, or in a Permanent Preservation Natural Vegetation zone • Environmental impact of a project affects two or more municipalities (including villages or towns) • The Federal government (i.e. Union) has delegated authority to a State or Federal Territory
Municipal Environmental Office	• The Federal or State government has granted authority for approval by law or contract, or by the Federal Territory environmental authority

2.2.5 Management of Hazardous Materials

The Ministry of Environment (MMA) is implementing a project in preparation to introduce PRTR (Pollutant Release and Transfer Register)[1] with technical assistance by the World Bank.[2] The World Bank project for hazardous chemical material risk management as part of their "Environmental Sustainability Agenda" is a component of this project, which includes the following activities.

- Definition of the types of information and data of the emissions of correlate elements.
- Identification of criteria for the selection of priority pollutants
- Proposal of guidelines for the companies and factories obligated to report using PRTR
- Proposal of guidelines for the declaration of emissions and transfers using PRTR.

This project to implement a PRTR system was initiated in 2008, and the proposal for the system was set for March 2009. In the project, the PRTR system will be used mainly by the chemical industries to manage harmful chemical substances. The chemical industry in Brazil is composed mainly of inorganic chemical manufacturing (soda manufacturing, nitric acid

[1] In Brazil, this is referred to as, Registro de Emissão e Transferência de Poluentes (RETP).
[2] According to the Brazil Ministry of Environment homepage and "Kick –off Workshop to launch a PRTR Projects for Latin America and the Caribbean NCPCs, June 2008".

production, phosphorus, fertilizer manufacturing, and industrial gas manufacturing), and organic chemical goods manufacturing (petrochemical and plastic resin manufacturing), agrochemical manufacturing, paints, solvents, ink manufacturing, catalyst agents, additive manufacturing, and so on, with 7,263 offices throughout the country in 2005 (about 13% of the total number of offices in Brazil).

2.2.6 Current Effects on the Environment

Based on available data the following effects of industrial waste on the environment are identified.

a. Water Pollution

Social and Environmental Program for the Igarapes in Manaus (PROSAMIM) financed by Inter-American Development Bank (IDB) is being carried out in the Study Area. "Industrial Pollution Prevention and Control Plan (PCCI)" is conducted as one of the components of PROSAMIM project. PCCI described the water quality of Igarape 40 of which catchment area covers Industrial District (DI) 1 and 2, as follows:

- The water quality of Igarape 40 is very bad due to domestic wastewater from population in the catchment area as well as industrial waste water from DI 1 and 2.
- Coliform index ranges from 250,000/100ml to 1,400,000/100ml. (Concremat, 2004)
- Dissolved Oxygen (DO) ranges from 0.4 to 3.0 mg/l. (Concremat, 2004)
- The water quality of Igarape 40 is contaminated by heavy metals of industrial wastewater such as copper, manganese, iron, zinc, nickel, cadmium, chromium and Lead. Its concentration is above the discharge standard established by the CONAMA Resolution 20/86.

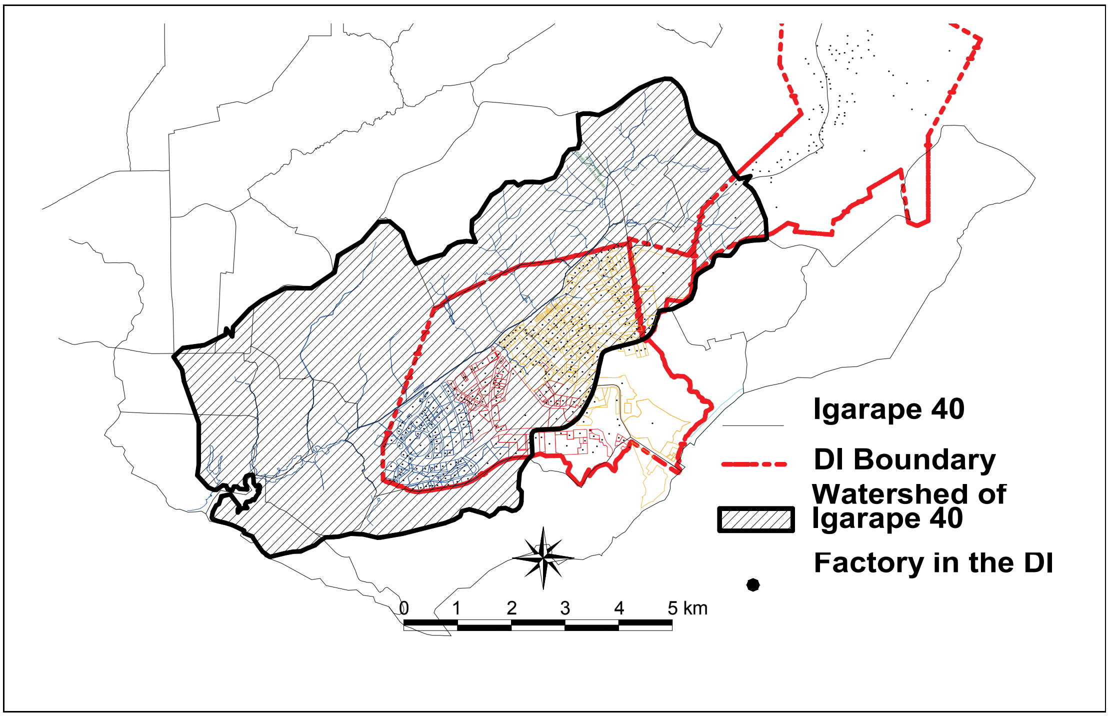


Figure 2-9: Industrial Districts (DI) 1 & 2 and Igarape 40

b. Illegal Dumping of Industrial Waste

In order to understand the situation concerning the illegal dumping of industrial waste, the Study Team investigated 16 illegal dumping sites in DI 1 & 2 in the beginning of April 2009. 15 sites, except one site located in DI 2, are cleaned and restored by SEMULSP. The waste illegally dumped at the site was health-care waste. It is doubtful that a collection company dumped the waste because of health-care waste and the dump site location, i.e. far inside of the DI 2.


Cleaned and Restored Dump Site in DI 1


Illegally Dumped Health-care Waste in DI 2

3. Supplement Studies on Current Conditions

3 Supplement Studies on Current Conditions

3.1 Contents of Supplement Studies

3.1.1 Contents of Supplement Studies

The first step in formulating the master plan for waste generated in the Industrial Pole of Manaus (PIM) is to gauge the characteristics and amount of that waste. An essential and most fundamental method to grasp the actual conditions of waste management is to produce a flowchart diagram, such as the one shown below. The key to producing this flowchart is to first divide the waste stream into two large categories: "on-site" management at the source of generation, and "off-site" management handled by waste service companies (WSCs).

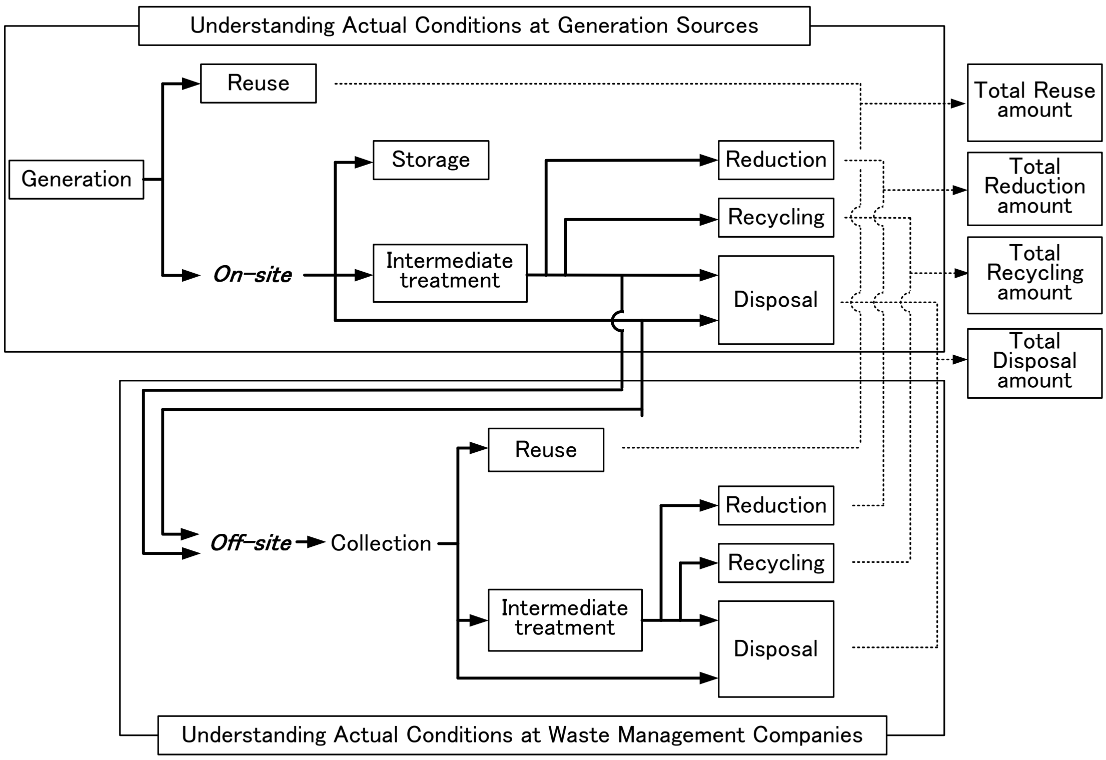


Figure 3-1: Waste Treatment Stream

The following supplemental studies were carried out in order to understand the current waste management conditions at the PIM generation sources, i.e. on-site management.

- Factory Survey
- Medical Institutions Survey
- Construction Waste Survey
- Radioactive Waste Survey

Furthermore, a supplemental study to survey waste service companies was conducted to grasp the current conditions of off-site management.

3.1.2 Waste Categories applied to the Study

Target waste of the Study is the waste which CONAMA Resolution 313 requests factories to report an inventory to the environmental authority. The waste requested by CONAMA Resolution 313 is broadly classified into the following four categories. Since each waste differs in its generation source and characteristics, the following surveys has been conducted to identify management of each waste:

- General industrial waste => Factory Survey
- Health-care waste => Medical Institutions Survey
- Construction waste => Construction Waste Survey
- Radioactive waste => Radioactive Waste Survey

The waste category applied to each study is described in each study report.

3.2 Study of Waste Service Companies

3.2.1 Outline of the Study

a. Study Objective

The study aims to survey the flow of PIM generated waste which is outsourced to waste service companies for collection and transport, treatment (reuse, recycle, rendering waste harmless, etc.) and final disposal. These results will be checked against the survey of generation sources, mentioned below, in order to clarify the waste stream after it is discharged from the PIM.

b. Study Method

A local consultant (OPCA: Olavo Branga & Paulo Farias Consultores Ambientais Ltda) was consigned to conduct the study. The local consultant visited and conducted interviews with waste service companies using a questionnaire form made by the study team.

The study team produced a draft of the questionnaire form to use as the basis for discussion with the C/P. Revisions were made based on that discussion, and then members of the study team accompanied the local consultant initially on a trial basis to further modify the questionnaire that was used in the full-scale survey. The following items were included in the questionnaire:

- General company information, number of employees, annual sales amount
- Types and amount of industrial waste handled
- Condition of equipment and facilities for collection and transportation, treatment (reuse, recycle, making harmless, etc.) and final disposal
- Industrial waste clients
- Approach toward and actual conditions of system and equipment for appropriate waste management
- Operational and environmental problems waste service companies are facing
- Demands related to government administration

- Other

c. Study Schedule

A local consultant (OPCA) was consigned to conduct the study on 6 April 2009. Beginning in late April, after preparations for the survey were made, the local consultant began the survey and completed interviews with 90 companies by the end of July. This data was to be compiled by the end of August, however, there were delays due to a necessity to clarify and add a number of companies not contained on the list received from IPAAM. Consequently, the interview survey has been conducted by the end of September and compilation of the results has been completed in November 2009.

3.2.2 Selection of Target Waste Service Companies

a. Registration System for Waste service companies in the State of Amazonas

Registration of waste service companies is handled by the Institute of Amazonas Environmental Protection (IPAAM). However, IPAAM does not register the companies themselves, but instead registers the environmental license of the waste service companies. The primary activity of IPAAM for environmental administration is to issue and manage environmental licenses, monitoring, and inspection; in this way, waste service companies are managed through the approval and issuance of environmental licenses.

b. Environmental Licensing

In the State of Amazonas, an environmental license must be obtained for any activity (industry) that could potentially impact the environment (Derecto No 10028 de 04 de Febreiro de 1987). These licenses are required not only for the installation and operation of factories, but for most activities where environmental impact is likely, including construction projects, agricultural, medical and so on. There are three environmental licenses, as follows: previous license, installation license and operation license.

c. IPAAM List of Waste Service Companies (WSCs)

IPAAM environmental licensing covers all industry that impacts the environment using a 4-digit code (01**). The first two digits designate the major division of industries into 32 classes, and the last two digits further divide these into sub-classes. The study team used this classification system to compile a list of waste related activities, as shown in the table below.

Table 3-1: Waste Service related Codes of IPAAM for Environmental Licensing

Code	Class	Code	Sub-Class	
				Impact
22∗∗	Commerce and Services	2217	Incineration	High
		2218	Co-processing of wastes	High
		2219	Agrochemical Collection Center	Moderate
24∗∗	Other Services (including provision of electricity and water)	2407	Solid Industrial Waste Collection and/or Treatment	High
		2408	Municipal Waste Final Destination	High
		2410	Collection and Transport of Inert Solid Waste	Minimal

		2411	Collection and/or Storage and/or Commercialization of Solid Waste (e.g. recycling)	Moderate
		2412	Collection and/or Treatment of Hazardous Liquid Industrial Waste	High
		2417	Industrial Waste Disposal in Landfill	High
26＊＊	Transportation	2615	Transport and Storage of Hazardous Solid Industrial Waste	High
30＊＊	Waste Treatment and Recycling	3001	Treatment and Recycling of Solid Industrial Waste without chemicals	Moderate
		3002	Treatment and Recycling of Industrial Liquid Waste	Moderate
		3003	Treatment and Recycling of Solid Industrial Waste without Chemicals	High
		3004	Treatment and Recycling of Palettes	Moderate
		3005	Paper and Cardboard Recycling	Moderate
		3006	Treatment and Recycling of Mineral Waste (Waste Re-processing)	Moderate

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

IPAAM and the study team agreed that the companies with the above sub-class codes would be the targets for the survey of waste service companies. As a result, IPAAM supplied a list of 84 companies (below, IPAAM WSC List) that had obtained environmental licenses for operation, as well as a 2-page summary for each company's environmental license.

d. Selection of Target Companies for the Survey

A local consultant (OPCA) was hired to conduct the study using the IPAAM list of waste service companies to contact the companies and ask them to participate in the survey. As shown in the table below, the survey was carried out with 35 companies.

Table 3-2: Results of Survey Participation using IPAAM WSC List

Survey Results		No. of Companies
1	Conducted survey	35
2	Companies with multiple environmental licenses	8
3	Target companies that could not be identified *1	17
4	Declined to participate	18
5	Target company does not exist, or ceased waste management operations	4
6	Target company not involved in waste management	2
Total		84

Note: *1: These companies could not be found when visiting the location as indicated on the environmental license, nor could it be identified via the phonebook, Internet, etc.

3.2.3 Execution of the Survey

a. Execution of the Survey

Of the companies on the IPAAM WSC List, only 35 could be surveyed. Then, the local consultant identified 55 waste service companies based on interviews with factories and waste service companies so that, as of September 30, 90 waste service companies were surveyed. The table below shows which of these companies currently has an environmental license for operation.

Table 3-3: Operating License Ownership (of 90 Waste Service Companies)

Operating License Ownership	No. of Companies
Has license	67*1
Does not have license	23*2
Total	90

Note *1: Of these 67 companies, 35 were identified on the IPAAM WSC List, and 25 were identified by the local consultant.

*2: These 23 companies were identified by the local consultant

b. Issues Identified from the Survey

Although the IPAAM environmental licenses have been digitized, the following issues were identified:

- The database server is old and does not function sufficiently. Furthermore, the database system is used for file management (to track where certain files are located), and thus is not set up for license management.
- Other information about IPAAM activities is mixed with the environmental license data and managed in the same database, making it extremely difficult to extract the license information needed.
- As shown in Table 3-1: Waste Service related Codes of IPAAM for Environmental Licensing, waste service companies are registered by codes for various related activities.

It became evident that not all of the waste service companies were shown in the IPAAM WSC List because it only lists those companies which have a code for waste management related activities. Also, once a list was compiled of the companies that are no longer in business or ceased their waste management related activities, it was not possible to identify them in the IPAAM WSC List, suggesting that licenses are not properly renewed and pointing to the need for a series of improvements to be made.

IPAAM indicated that improvements will be made to their registration system for waste service companies so it will be more effective. Furthermore, those companies without environmental licenses will be encouraged to register, and the system reinforced by updating the database of IPAAM waste service companies—which will be constructed during this study.

3.2.4 Results of the Survey

a. Waste Service Company Survey and Environmental Licensing

a.1 Environmental License Owners

There were 90 waste service companies (WSCs) surveyed from which the following results were found.

- Companies that have obtained environmental licenses: 67
- Companies that have not yet obtained environmental licenses: 23

a.2 Responses from WSCs by business sector and business conducted

The following table is based on the responses from 90 WSCs surveyed showing the business sectors divided into 4 categories of 1) collection and transportation, 2) intermediate treatment, 3) final disposal, and 4) reuse and recycling. Some companies were engaged in multiple practices, so the total number amounts to 127.

Table 3-4: Responses from WSCs according to business sector

Environmental License Ownership	1) Collection and transportation	2) Intermediate treatment	3) Final disposal	4) Reuse and recycling	Total
Yes	41	9	10	42	102
No	7	0	0	18	25
Total	48	9	10	60	127

The above results were summarized according to amount of business conducted (management amount) into four categories, based on the answers of 90 companies, as follows.

Table 3-5: Responses from WSCs by business sector and business conducted (management amount)

Unit: ton/Day

Business Sector	Waste Division	Env. License Owner	No Env. License	Total
Collection and Transportation	Hazardous	97	0	97
	Non-Hazardous	3,240	6	3,246
	Sub-total	**3,337**	**6**	**3,343**
Intermediate Treatment	Hazardous	42	0	42
	Non-hazardous	266	0	266
	Sub-total	**308**	**0**	**308**
Final Disposal	Hazardous	8	0	8
	Non-Hazardous	2,250	0	2,250
	Sub-total	**2,258**	**0**	**2,258**
Reuse and Recycling	Hazardous	11	0	11
	Non-Hazardous	166	1	168
	Sub-total	**177**	**2**	**179**

a.3 Business Sector and Business Conducted (Management Amount) as analyzed by the Study Team

The following table shows the business sector of 67 waste service companies that have environmental licenses based on an examination by the study team with support from the local consultant.

Table 3-6: 67 WSC Environmental License Owners by business sector

Env. License Ownership	Collection and Transportation	Intermediate Treatment	Final Disposal	Reuse and Recycling	Not Classified*1	Total
Yes	26	24	0	21	4	75

Note *1: The business sector could not be identified on the license. The licenses indicated the following: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide (1 comp.), 3. Retailer of wood products (1 comp.)

As shown in the table above, waste service companies that responded they own the final disposal operation license, but the result of checking the 67 companies revealed that none of them owns the license. In the State of Amazonas, and including Manaus City, there is no final disposal site which owns an environmental license, so it is reasonable that the findings of the study team pertaining to final disposal are valid. In addition, problems with the licensing of other waste service companies have been confirmed as follows. A description of the above table is given as follows:

- Not classified: Case where a WSC is conducting incineration treatment with an environmental license for water supply, not waste disposal. In this case, a license should clearly be obtained for waste disposal activities.
- Reuse and Recycling: Of the 17 companies classified for reuse and recycling, 11 companies have an environmental license code for that other than waste-related activity. Paper or aluminum processing plants are using their primary business licenses to conduct reuse or recycling of waste as part of their operations. In this case, in addition to their primary business license, it is necessary to investigate the framework for a new license, such as obtaining a license for the reuse and recycling of waste.
- Intermediate treatment: There are many businesses that should be categorized not under intermediate treatment, but under reuse and recycling.

Solutions to the above challenges are closely related to how the database to manage WSCs at IPAAM is constructed and the policy used to manage it.

Table 3-5: Responses from WSCs by business sector and business conducted (management amount), was reorganized according to Table 3-6: 67 WSC Environmental License Owners by business sector. The findings show the waste service amount by 90 WSCs according to their ownership of environmental licenses at present.

Table 3-7: WSCs by business sector and business conducted as Examined by the Study Team

Unit: ton/Day

Business Sector	Waste Type	Env License Owner	No Env License	Total
Collection and Transportation	HIW	52	45	97
	Non-HIW	2,895	350	3,246
	Sub-total	**2,948**	**395**	**3,343**
Intermediate Treatment	HIW	42	0	42
	Non-HIW	265	1	266
	Sub-total	**307**	**1**	**308**
Final Disposal	HIW	0	8	8
	Non-HIW	0	2,250	2,250
	Sub-total	**0**	**2,258**	**2,258**
Reuse and Recycle	HIW	10	1	11
	Non-HIW	13	155	168
	Sub-total	**23**	**156**	**179**

a.4 Location of WSCs

The location of the 90 companies is shown in the table below. Of these, 87 are located in the industrial district or in the city of Manaus.

Table 3-8: Location of WSCs

Location	License Owner	No License	85 Companies	Ratio
1. Industrial District 1	9	6	15	17%
2. Industrial District 2	12	1	13	14%
3. Outside of Industrial District, but inside of Manaus City Zone	43	16	59	66%
4. Outside of Manaus City Zone	3	0	3	3%
Total	67	23	90	100%

a.5 Size of WSCs (Number of Employees)

The number of employees at waste service companies was sought according to their possession of an environmental license.

This survey revealed that number of (managerial and operational) employees at small or very small enterprises with less than 10 employees was 36% (i.e. 32 of 90 companies), but for the 21 enterprises without an environmental license, it was found that 21 were small or very small enterprises. On the other hand, of the 9 large enterprises with over 100 employees, the number of businesses that specialize in industrial waste management—thus excluding cement production, sale of construction materials and collection or disposal of municipal waste—was three. Presently, these large waste service companies are made up of three central groups.

Table 3-9: Size of WSCs and License Ownership

	No. of Employees	90 Companies	Ratio	Env License Owner	No Env License
1.	Less than 10	32	36%	11	21
2.	10 – 50	39	43%	38	1
3.	50 – 100	7	8%	7	0
4.	More than 100	9	10%	8	1*1
5.	No answer	3	3%	3	0
	Total	**90**	**100%**	**67**	**23**

Note *1: There was one company with over 100 employees and no environmental license which sells construction materials as its primary business.

b. Collection and Transportation

b.1 Amount Collected/Transported

Of the 90 WSCs surveyed, the total amount collected and transported, as shown in the following table, is 3,343 ton/day. This amount is some five times the total amount of 628.9 ton/day of industrial waste discharged from PIM according to the factory survey.

Thus, a detailed analysis of the collection companies from the results of the survey of 90 WSCs is as follows.

Table 3-10: Detailed Breakdown by Scale of Business Conducted (Collection and Transportation) of Collection and Transportation Companies

Scale (collection amount)	WSCs for Collection and Transportation	Hazardous Waste	Non-Hazardous Waste	Total
Without License	20*1	44.7	350.3	395.0
1. less than 100 ton/day	19	4.1	148.5	152.6
2. 100 to 300 ton/day	1	40.6	201.8	242.4
With License	19*2	52.4	2,895.4	2,947.9
1. less than 100 ton/day	14	27.4	160.9	188.3
2. 100 to 300 ton/day	3	17.1	471.2	488.3
3. more than 300 ton/day	2	8.0	2,263.3	2,271.3
Grand Total	39	97.1	3,245.7	3,342.8

Note *1: 20 of the 22 companies responded with their collection amounts

*2: 19 of the 26 companies responded with their collection amounts

According to the table above, the two companies which are collecting over 300 ton/day are the two companies contracted to collect the municipal solid waste (MSW) of Manaus City. Thus, if this collection amount is taken to be MSW, the remaining collection and transportation amount is 1,071.5 ton/day. The following table summarizes the collection and transportation amount information obtained in the Off-site Survey (Survey of WSCs) and On-site Survey (survey of PIM generation sources: factories, medical institutions, construction). With the exception of the two companies that are clearly collecting MSW, the collection and transportation amount from the Off-Site Survey resembles that which was found for the On-Site Survey (Survey of generation sources) of PIM manufacturing, construction, and health-care waste.

Table 3-11: Comparison of Off-Site Survey and On-Site Survey Results for Collection and Transportation Amount

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount Collected/Transported	3,342.8	NA
2. Municipal Waste (2 companies)	2,271.3	NA
3. Industrial Waste	NA	591.5
4. Construction Waste	NA	37
5. Health-care Waste	NA	0.4
3 + 4 + 5	1,071.5	628.9

b.2 Conditions of Collection and Transportation

A large amount of recyclable material, such as plastic, paper and cardboard, and metals collected from MFZ is handled by large companies. In other words, the three major waste collection and transportation companies send their employees to waste centers located in the factories of large waste generating companies and have exclusive access to conduct separate collection of their recyclable materials. Based on this study, most used paper and 80% of scrap metal is collected by the three large collection and transportation companies. One of these large companies collects most of the waste plastic, and after separation and removal of foreign material, melts it will an extruder, cools it and makes pellets which are then used as raw material to make recycled plastic resin, and finally plastic products which are sold to manufacturing companies.

There is a factory that reuses waste paper in the study area, but no factory that reuses scrap metal, so with the exception of aluminum, most of the scrap metal is sent to companies in Sao Paulo, Rio de Janeiro and other places.

c. Intermediate Treatment

c.1 Intermediate Treatment, Reuse and Recycling

Since intermediate treatment has the function of producing valuable by-products such as compost, electricity, etc. the difference between intermediate treatment and reuse/recycling is generally a difficult issue. It is necessary to clearly regulate these in order to separate them.

The difference between the environmental licenses (EL) needed for intermediate treatment and reuse/recycling is unclear, and company declaration is also ambiguous. The following table shows the differences of the business practices based on the license of the 67 WSCs as well as the business practices as declared in their responses.

Table 3-12: Business Practices based on the Licenses of 67 WSCs with Env Licenses and the Business Practices of 90 WSC Respondents

Env License Ownership	1) Collection and Transportation	2) Intermediate Treatment	3) Final Disposal	4) Reuse/Recycling	Total
1. Total WSC Respondents	**48**	**9**	**10**	**60**	**127**
Those without an EL	7	0	0	18	25
Those with an EL	41	9	10	42	102
2. Business practices based on the licenses of 62 WSCs	**26**	**24**	**0**	**21**	**71**

c.2 Intermediate Treatment Amount

As can be seen in the table above, there is a large difference concerning intermediate waste treatment between the WSC respondents (9 companies) and the business practices based on environmental licenses (24 companies). Thus, the amount of intermediate treatment was summarized based on the answers from companies as shown below. This table indicates only one WSC treats 90% of wastes for intermediate treatment.

Table 3-13: Breakdown according to Scale of Intermediate Treatment Companies based on the Responses of Waste service companies (7 companies [*1])[*2]

Unit: ton/day

Scale (Intermediate Treatment Amount)	Intermediate Treatment Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	2	0.2	0.7	0.9
1. less than 100ton/day	2	0.2	0.7	0.9
With License	5	41.9	265.6	307.5
1. less than 100ton/day	4	1.3	29.0	30.3
2. 100 to 300 ton/day	1	40.6	236.6	277.2
Grand Total	7	42.1	266.3	308.4

Note *1: 7 out of 9 companies responded with their intermediate treatment amount

*2: In this study, the largest treatment company of health-care wastes was not included.

The results for intermediate treatment were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The result shows similar values.

Table 3-14: Comparison of intermediate treatment amount for the Off-site Survey and the On-site Survey

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount of Intermediate Treatment	308.4	246.5
2. Non-HIW of the 1. (above)	266.3	175.4
3. HIW of 1. (above)	42.1	71.1

c.3 Conditions of Intermediate Treatment

There are 25 companies that have environmental licenses for intermediate treatment, but of those, many are actually conducting recycling operations. One waste treatment company is conducting incineration service, and is treating a large amount of waste. The only cement factory in Amazonas State is conducting co-processing in its cement kiln. Based on the study data, the waste primarily being treated/used is waste tires (300 ton/month), waste molding sand (95 ton/month), and sludge from plating (30 ton/month). Mixing in the materials yard, they also input waste to the kiln (into a suspension pre-heater hatch), but the waste is brought up by a conveyor not an elevator and also requires manpower. Also, there is a little substitution of fuel with waste oil, the authentic treatment/reuse is happen from now.

d. Reuse/Recycle

d.1 Reuse/Recycle Amount

Similar to intermediate treatment, there is a large difference for reuse and recycling claimed by the WSC respondents (60 companies) and the business practices based on environmental licenses (21 companies). Thus, the reuse/recycle amount was based on the response from companies and summarized in the table below. This table indicates 82% (14 of 17 WSCs) are small companies which manage less than several ton of waste per day.

Table 3-15: Breakdown of Reuse/Recycle Amount by Scale of Company according to WSC Respondents (49 companies [*1])

Unit: ton/day

Scale (Reuse/Recycle Amount)	Reuse/Recycle Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	32	10.3	22.2	32.5
1. less than 100ton/day	32	10.3	22.2	32.5
With License	17	0.8	145.7	146.5
1. less than 10ton/day	14	0.8	17.3	18.1
2. 10 to 50ton/day	2		61.7	61.7
3. more than 50ton/day	1		66.7	66.7
Grand Total	49	11.1	167.8	178.9

Note *1: 49 of 60 companies responded with their reuse/recycle amount

The results for reuse and recycle amount were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The off-site survey and the on-site survey results show similar values.

Table 3-16: Comparison of Survey Results (Reuse/Recycle Amount) for WSCs and PIM Generation Sources (factories, medical institutions, construction projects)

Unit: ton/day

Waste	Survey Results of WSCs	Survey Results of PIM Generation Sources
1. Total Amount of Reuse Recycle	178.9 (487.3)	220.2 (466.7)
2. Non-HIW of 1. (above)	167.8 (434.1)	200.2 (375.6)
3. HIW of 1. (above)	11.1 (53.2)	20.0 (91.1)

Note *1: The number in parentheses are the total of intermediate treatment amount and reuse/recycle amount

d.2 Conditions of Reuse/Recycle

There are 60 companies that are conducting the reuse and recycling of waste, including those which do not possess an environmental license. However, upon examination of the environmental licenses themselves, there were 17 companies. Of these 17, there were 11 that had an environmental license code other than for waste management. All of them were conducting the reuse and recycling of industrial waste. As above, time is being given to check the activities of reuse and recycling activities. Even for those companies that do have licenses, there are many uncertainties concerning their activities. The reason for this is that the environmental license is only specified under "(industrial) activities that have potential environmental impact" for waste treatment and recycle (30＊＊) subcategory 3004 for treatment and recycling of palettes, and 3005 for recycling waste paper products and cardboard, whereas the other activities are ambiguous concerning this point.

Table 3-17: Waste Treatment and Recycling Activities for (Industrial) Activities with Potential Environmental Impact

Category Code	Category Description	Subcategory Code	Subcategory Description	Potential Impact
30＊＊	Waste Treatment and Recycling	3001	Solid Industrial Waste Treatment and Recycling without the use of chemicals	Mid
		3002	Treatment and Recycling of Liquid Industrial Waste	Mid
		3003	Solid Industrial Waste Treatment and Recycling with the use of chemicals	High
		3004	Treatment and Recycling of Palettes	Mid
		3005	Recycling of Waste Paper Products and Cardboard	Mid
		3006	Treatment and Recycling of Metal Waste (Waste Reprocessing)	Mid

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

The types of waste that are reused/recycled in the study area are limited to: used lubricating oil, used molding sand, aluminum scrap, waste paper, used paint, and used ink cartridges from printers, etc.

e. Final Disposal

e.1 Final Disposal Amount

Out of the WSCs surveyed, nine responded that they conduct final disposal activities. However, the results of examining the environmental licenses of the companies that responded revealed that none of them have environmental licenses for final disposal. Also, IPAAM reported that there is no landfill in MFZ, including the Manaus city landfill, which is not licensed for final disposal. Therefore, the following table summarizes the amount of final disposal based on the respondents.

Table 3-18: Breakdown of the Scale of Final Disposal Amount based on the WSC respondents (6 companies *1)

Unit: ton/day

Scale (Final Disposal Amount)	Final Disposal Company	Hazardous Waste	Non-Hazardous Waste	Total
Without License	6	8.0	2250.1	2258.1
1. less than 100 ton/day	4	0.0	3.0	3.0
2. more than 300 ton/day	2	8.0	2247.0	2255.0
Grand Total	6	8.0	2250.1	2258.1

Note *1: 6 of 9 companies responded their collection amount

In the above table, the 2 companies that conduct final disposal of more than 300 tons/day are the two disposal companies contracted to collect municipal waste in Manaus City and dispose of it using the city landfill. The amount collected and transported by these two companies is 2,271.3 ton/day, which is largely consistent with the final disposal amount. Therefore, the table above does not include the final disposal amount revealed in the On-site Survey of manufacturing (industrial), construction and health-care waste from PIM, which is 135.8 ton/day (98.5 + 37.0 + 0.3, respectively).

It is assumed that this amount of waste is being disposed of in landfill sites other than the Manaus city landfill.

e.2 Conditions of Final Disposal

Final disposal operation of the WSC respondents (9 WSCs) is categorized into the following categories.

Table 3-19: Type of Final Disposal Operation by WSC Respondents (9 WSCs)

Industrial + Health-care + Construction Waste	Construction Waste	Municipal Solid Waste	Wastewater Disposal	Total
1	3	2	3	9

There are two companies which are contracted by Manaus City that collect and dispose common waste. These two companies also collect and dispose medical and construction waste from factories in the industrial districts, etc. However, without their own final disposal sites, they must use the Manaus City final disposal site. There are three companies that dispose of construction waste which also use the Manaus final disposal site. Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.

f. Off-Site Industrial Waste Management Issues

Interviews during the survey of WSCs and related companies raised the following issues.

f.1 Issues Revealed in the Survey of WSCs

f.1.1 Enforcement of Laws and Regulations

- The government policy on industrial waste management is unclear and ambiguous (52 of 85 respondents)
- Insufficient industrial waste management system, monitoring (55 of 85 respondents)
- In the study area, not all of the companies are using a manifest (29 of 89 respondents are using a manifest)
- Illegal dumping is a problem (77 of 88 respondents)
- Overall social awareness of waste management is low (79 of 88 respondents)
- The capacity of organizations regulating and controlling waste management need to be strengthened (64 of 85 respondents)

f.1.2 Business Environment of WSCs

- There is no system of financial support (tax exemption, etc) from public organizations for waste management equipment or pollution control equipment. Companies would like to see such support. (60 of 66 respondents)
- A database for waste discharge is needed (72 of 79 respondents)
- Instruction and training on waste management is needed (73 of 79 respondents)
- High cost of electricity contribute to high costs (63 of 79 respondents)
- There is no wastewater treatment system that covers all of the industrial districts or Manaus city area (54 of 83 respondents)

f.2 Issues Revealed through Interviews with Stakeholder Organizations and Site Visits to WSCs

f.2.1 Environmental Licensing

These issues are from analysis of the environmental licenses offered by the Institute of Amazonas Environmental Protection (IPAAM) and related documents, as well as interviews with IPAAM.

- IPAAM has entered information on environmental licenses into a database, but the server is old and does not function sufficiently. Furthermore, the database system serves to support document management, not a system to manage the licenses.

Companies also feel that the approval and renewal process for licenses from IPAAM is slow.

- Of the activities that require environmental licenses because of potential environmental impact, the activities related to waste management are distributed to more than one classification, so it is necessary to integrate and restructure them.
- The activities listed on the environmental licenses are too common. Also, the activities that companies have been approved for often differ from the actual activities they are engaged in, and it is necessary for them to obtain licenses for those activities.
- There seem to be many cases where recycling activities have been granted environmental licenses with the code for treatment. Also, some companies are using waste has raw material (companies that are recycling waste) and have environmental licenses for the production of those products, so it is necessary to investigate the recycling activity code.
- IPAAM needs to strengthen its monitoring of approval conditions and regulatory requirements written on the environmental licenses.

f.2.2 Manifest

- Dischargers are not obligated to the manifest (industrial waste management sheets) by law or regulation. Also, the forms used for the manifest are from companies, not uniform.

f.2.3 Enforcement of Laws and Regulations

- The rights and responsibilities of the Municipal Secretariat of the Environment (SEMMA) and IPAAM for the enforcement of environmental laws and regulations are unclear. WSCs are dissatisfied with this.
- The Brazilian Association for Technical Specifications of waste categories, regulation ABNT 10004 is too detailed and difficult to utilize because it is impractical. Also, it is not generally understood.
- There are very few staff members or engineers with knowledge and experience with waste management at IPAAM, and SUFRAMA.

f.2.4 Lack of Companies with Appropriate Equipment and Skills, and Lack of Infrastructure (Facility)

- Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.
- In the study area, there are almost no companies dealing in the reuse of iron and non-ferrous metal scrap (except aluminum). Such waste is collected and sent to companies in places like Sao Paulo and Rio de Janeiro.

f.2.5 Unclear Treatment and Disposal Stream of Hazardous Waste

- One company that refused to cooperate with the survey of WSCs has been indicated to deal with a large amount of waste, and is manufacturing and selling asphalt filler made of a mixture of 5% waste. It is unclear whether this company is dealing with hazardous wastes.

- Non-hazardous waste and health-care waste from factories in the Industrial Districts are being disposed of in the Manaus City municipal landfill. However, in the cases where factory hazardous waste and health-care waste is not well separated from non-hazardous waste, it ends up being disposed of in the municipal landfill.

f.2.6 Business Environment of WSCs

- Co-processing of wastes in a cement kiln has begun, but the amount of waste in the study area is unclear so this has not been fully developed. The cost of co-processing is competitive with the cost of incinerating waste and final disposal.

3.3 Study of Waste Management in Factories

3.3.1 Outline of the Study

a. Study Objective

The study aims to clarify the current conditions of industrial waste management at the source of generation by visiting the PIM factories where waste is generated and conducting an interview survey to assess operation conditions, the types and amounts of wastes generated and the conditions of industrial waste management.

b. Study Method

A local consultant (SEA LTD.) was consigned to conduct the study. The local consultant visited and conducted interviews with target factories using a questionnaire made by the study team.

The study team produced a draft of the questionnaire to use as the basis for discussion with the C/P. Revisions were made based on that discussion, and then members of the study team accompanied the local consultant initially on a trial basis to further modify the questionnaire that was used in the full-scale survey. The following items were included in the questionnaire:

- General factory information, factory name, type of industry, number of employees, scale of production, value of annual shipment
- Kinds of industrial wastes, amount generated and amount discharged
- Storage, treatment and reuse/recycle methods for industrial wastes, and related costs (on- and off-site information)
- Needs for government administrative support
- Problems faced with management of industrial wastes
- Needs for a waste exchange database
- Future production plans, process improvements, environmental measures, etc. to be taken
- Existence of a clinic on premises
- Discharge of radioactive and construction waste
- Other

c. Study Schedule

A local consultant (SEA LTD.) was consigned to conduct the study on 27 March 2009. Immediately after the contract was signed, the trial survey was implemented, and upon appropriate revisions and additions to the draft questionnaire sheet, a full-scale survey was begun in late April, and the direct interviews were to be completed by late July. The results were to be compiled into a report in August, but delays in the interview process led to an extension into September. Therefore, the first analysis report was made based on the data from 134 factories obtained by August 17th. When the direct interviews were completed at the end of September, the additional data from the 53 factories were included and the first analysis report was modified to reflect those additions.

The primary causes for the delay in the factory survey were as follows:

- Although a draft of the questionnaire sheet was sent in mid-May to 339 factories, by the end of July, only 106 factories, at most, had returned the completed questionnaires.
- Furthermore, direct interviews were to be conducted based on the returned questionnaires, but the time required to obtain permission to visit the factories were greater than expected.

3.3.2 Target Wastes

a. Categories of Industrial Waste in CONAMA Resolution 313

The National Environment Council (CONAMA) issued their Resolution 313 on 29 October 2002. CONAMA Resolution 313 requires specified industries to report (using a waste inventory) on management conditions for industrial waste generated through industrial activity. CONAMA Resolution 313 designates that the inventory is produced in accordance with the Brazilian Association of Technical Standards (ABNT) NBR 10004, which stipulates the categorization of wastes.

b. Target Wastes

The target wastes are those generated by PIM which are designated in CONAMA Resolution 313 for inventory formulation.

c. Categories of Target Wastes

CONAMA Resolution 313 was issued and went into effect on 29 October 2002. Despite the fact that SUFRAMA also began to receive a number of waste inventories from PIM factories in 2001[1], neither the types and amounts of PIM generated wastes nor the actual management practices were understood at the start of this study. This indicates an inadequate system to manage this at SUFRAMA; however, the failure to grasp actual conditions of waste management in most cases is the immense and complicated categorization of waste that makes it exceedingly difficult to identify.

[1] In 2001, the Public Ministry of the State of Amazonas, through Recommendation No. 003/2001, advised SUFRAMA to obtain an operation license for PIM and for each PIM factory to submit a waste inventory. In response, SUFRAMA appealed to the PIM factories to submit their waste inventories, which a number of factories, in turn, submitted.

CONAMA Resolution 313 condensed waste categorization in ABNT NBR 10004 in order for factories to make their waste inventories; however, it remained difficult to identify to which category the generated wastes would be attributed. Thus, the study team held repeated discussions with the C/P to categorize wastes as follows in order to conduct the present study:

1. Industrial Waste will be broadly divided into the following categories.

- Non-HIW (Non Hazardous Industrial Waste) generated from Non-production process
- HIW (Hazardous Industrial Waste) generated from Non-production process
- Non-HIW generated from Production process
- HIW generated from Production process

2. Given the above, it was reasoned that making it easier for the creators of the waste inventory--i.e. the factories--to identify the wastes generated, that it would in turn become easier for those receiving the waste inventory to compile and manage that information. To do so, wastes were grouped to the greatest extent possible into 13 non-hazardous and 16 hazardous categories, each with their own respective code, as shown in the table below.

Table 3-20: Non-Hazardous Industrial Waste Categories used in the Study

Type of Non-HIW	Non-HIW Code
Kitchen waste (include waste from animal such as bone, skin, hair)	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Animal oil, Vegetable oil	NH06
Rubbers and Leather	NH07
Ash/dust from coal-fired power plants, etc.	NH08
Metals and metal alloys such as aluminum, copper, bronze	NH09
Ceramic & Glasses	NH10
Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH11
Mixed waste (This code shall be applied in case wastes are discharged without separation.)	NH12
Others	NH13

Source: JICA Study Team

Table 3-21: Hazardous Industrial Waste Categories used in the Study

Type of HIW	HIW Code	Example of HIW
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic Compounds	HW04	including Hg, As, Cd, Pb, Cr, CN
Inorganic Compounds	HW05	Plating wastes, Picking waste, Sulphides, etc.

Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.
Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge	HW11	Inorganic sludge, Organic sludge, Septic tank sludge, etc.
Ash from incinerator	HW12	---
Dust and Air pollution control (APC) products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above
Mixed Waste	HW15	---
Hazardous materials from Non-production process	HW16	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.

Source: JICA Study Team

3.3.3 Selection of Target Factories

a. Basic Considerations

At the beginning of the study, the Study Team planned to select 200 factories[1] located in PIM and it was planned to select 180 PIM factories and 20 PIM subcontractors and non-PIM factories. However, upon discussion with the C/P, it was decided to abandon non-PIM factories for the following reasons:

- The majority of PIM subcontracted factories are licensed by SUFRAMA and PIM factories are the ones receiving tax benefits.
- The non-PIM factories are non-registered cottage industries, and the C/P was not in possession of the locations and other such basic data that would be required for the study, making it impossible for the C/P to conclude which factories would be targeted.

b. Factory Industrial Sectors for Conducting Survey of Generation Sources

The 19 industrial sectors, as reported in "Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA" (Source: CGPRI & CGMER/COCAD SUFRAMA, up to 8/2008), were used when conducting the survey of generation sources.

[1] It is preferable to survey as many factories as possible. However, considering limited time of the survey and experience of the previous similar study, it was decided as 200.

c. Factory List

SUFRAMA formulates a list of PIM factories[1], hereafter referred to simply as the SUFRAMA factory list. In this list, the PIM factories are divided into four categories, or parts.

1. Part 1: Complete Projects Approved and Installed in PIM
2. Part 2: Simplified Projects Approved and Installed in PIM
3. Part 3: Complete Projects Approved and Under Installation in PIM
4. Part 4: Simplified Projects Approved and Under Installation in PIM

Here, the division between complete and simplified depends on criterion such as production output—complete projects are 2 million USD and above.

d. Selection of Target Factories

The target factories for the study were chosen by selecting 200 from the total 457 listed in Part 1 and 2 of the SUFRAMA Factory List. The following criteria were used to make the selection:

1. The PIM is divided largely into two Industrial Districts (DIs), as well as those outside the DIs, and target factories were to be selected from each.
2. A minimum number of factories to be surveyed in each industrial sector were established in order to grasp the waste management conditions in as many of the 19 sectors as possible.

Based on the above criteria, the C/P and Study Team established the minimum number of factories to be surveyed in each sector. A local consultant (SEA LTD.) was consigned to carry out the survey.

Although the Study Team intended to 200 factories, due to the following difficulties, the local consultant has completed 187 factories. This report, therefore, was based on the analysis of data completed for 187 factories.

- Time limitation;
- Insufficient cooperation of factories selected; and
- Some information of the factories provided to the study team was not updated.

Table 3-22: Number of PIM Factories and Number of Samples for Factory Survey

Factory Code	Sector	Inside Industrial District			Outside Industrial District			Total No. of Factories (A)	Target Factories	
		Part 1 No. of Factory	Part 2 No. of Factory	Sub-total	Part 1 No. of Factory	Part 2 No. of Factory	Sub-total		No. Surveyed (B)	Ratio (%) (B/A)
F01	Beverages	3		3	12		12	15	5	33.3
F02	Leathers									
F03	Printing	6		6	3	7	10	16	6	37.5

[1] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

F04	Electric/-tronic	64	1	65	51	5	56	121	65	53.7
F05	Wood	2		2				2	0	0.0
F06	Mechanical	19		19	9		9	28	17	60.7
F07	Metallurgy	23	2	25	19	3	22	47	19	40.4
F08	Non-metallic Minerals		1	1	2	3	5	6	1	16.7
F09	Furniture	1		1	3	1	4	5	2	40.0
F10	Paper	7		7	6		6	13	7	53.8
F11	Rubber	2		2	1		1	3	0	0.0
F12	Food Products				4	9	13	13	3	23.1
F13	Chemical	13	2	15	15	4	19	34	12	35.3
F14	Plastic	31	2	33	35	7	42	75	24	32.0
F15	Textile				1		1	1	0	0.0
F16	Fabric				2		2	2	0	0.0
F17	Transport mat.	15		15	16	2	18	33	19	57.6
F18	Construction		1	1	2	3	5	6	0	0.0
F19	Others	7		7	5	8	13	20	7	35.0
	Total	193	9	202	186	52	238	440	187	42.5

Source: Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008), and JICA Study Team

3.3.4 Execution of the Survey

a. Survey Procedures

The procedures which were carried out for the survey are shown in the following figure.

First, a trial survey was conducted in order to complete the draft questionnaire. Next, the modified questionnaire was to be sent to all 457 target factories accompanied by a letter from SUFRAMA requesting their cooperation for the study. Then, when the questionnaires were returned, upon looking over the responses, direct interviews were conducted at the factories to complete the questionnaires.

The questionnaire sent to target factories is shown in the Supporting Report, sub-section 2.2.

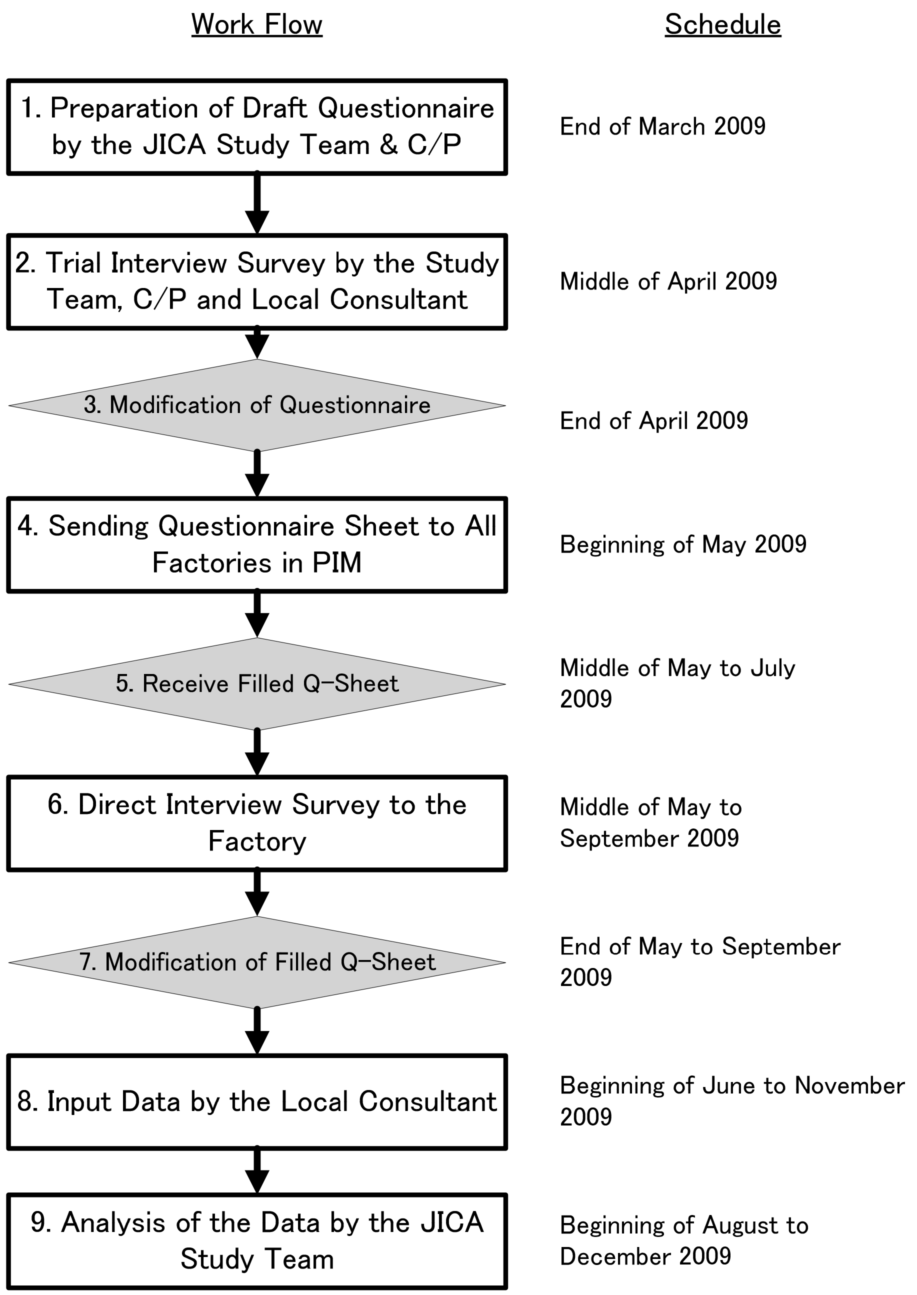


Figure 3-2: Work Flow of the Factory Survey

b. Survey Implementation Issues

Initially it was planned to send the questionnaire along with a letter of request from SUFRAMA to all 457 factories in Part 1 and 2 of the SUFRAMA factory list. However, because some of these factories were no longer located as indicated on the factory list, and others were no longer operating, the actual number of factories to which the questionnaire was distributed was 339. Furthermore, by the end of July, the number of factories that had returned the questionnaire with their answers was at most 106. As a result, the procedures for the factory survey were greatly delayed.

Given the above results, it is necessary to resolve the following issues so that when SUFRAMA conducts factory surveys at regular intervals in the future it will be possible to grasp any change in the condition of waste and environmental management in the PIM.

- Increase the reliability and accuracy of the SUFRAMA factory list
- Explore and execute measures to promote PIM factories to comply with the factory survey.

3.3.5 Results of the Survey

In this section industrial waste (IW) means general industrial waste (GIW). It should not include health-care, construction and radioactive wastes.

a. Generation Amount

a.1 Factories Surveyed

The following table shows the 187 factories that were surveyed in order to create this report. At present, this is 42.5% of the total number of factories (440) operating in PIM/MFZ.

Table 3-23: Detail on Factories Surveyed

Factory code	Industrial District (DI)			Outside DI			Total number of factory (A)	Surveyed number of factories	
	Number of Factory			Number of Factory					
	Part 1	Part 2	Sub-total	Part 1	Part 2	Sub-total		Number (B)	% (B/A)
F01	3		3	12		12	15	5	33.3
F02									
F03	6		6	3	7	10	16	6	37.5
F04	64	1	65	51	5	56	121	66	54.5
F05	2		2				2		0.0
F06	19		19	9		9	28	17	60.7
F07	23	2	25	19	3	22	47	19	40.4
F08		1	1	2	3	5	6	1	16.7
F09	1		1	3	1	4	5	2	40.0
F10	7		7	6		6	13	7	53.8
F11	2		2	1		1	3		0.0
F12				4	9	13	13	3	23.1
F13	13	2	15	15	4	19	34	12	35.3
F14	31	2	33	35	7	42	75	23	30.7
F15				1		1	1		0.0
F16				2		2	2		0.0
F17	15		15	16	2	18	33	19	57.6
F18		1	1	2	3	5	6		0.0
F19	7		7	5	8	13	20	7	35.0
Total	193	9	202	186	52	238	440	187	42.5

a.2 Responses on the Generation Amount of Industrial Waste

Of the 187 factories surveyed, 170 supplied valid answers to their amount of industrial waste generated (17 factories only answered the general items). The following table shows the answers of 170 factories indicating a total of 1,876 wastes. However, of this number, estimations for the amount of Item B: Health-care Waste and Construction Waste were done in separate surveys, and are therefore excluded. Since the effluent is not included in waste categories in this study, it is also excluded. The amount of effluent generated is as follow:

- Generation amount for target factories: 13,256 m^3 per year/36.3 m^3 per day
- Generation amount for all PIM factories: 22,960.7 m^3 per year/62.9 m^3 per day

Here, items indicated “m^3 per year” were converted to 1 ton/m^3.

Table 3-24: Responses for General Industrial Waste Generation Amount

Factory Code	A. Number of Wastes by Responding Factories	B. Eliminated Waste Items (Health-care, Construction, Effluent)	C. No. of Wastes used to estimate waste amount	D. Items showing ton/year from Items in C	E. Items showing m3/year
F01	40	1	39	38	1
F02					
F03	54	1	53	50	3
F04	771	34	737	677	60
F05					
F06	173	8	165	154	11
F07	136	2	134	118	16
F08	23	1	22	22	0
F09	2	0	2	2	0
F10	53	7	46	42	4
F11					
F12	13	0	13	12	1
F13	88	1	87	79	8
F14	203	10	193	173	20
F15					
F16					
F17	221	7	214	197	17
F18					
F19	99	3	96	92	4
Total	**1,876**	**75**	**1,801**	**1,656**	**145**

a.3 Number of Employees

The number of employees among the 170 factories that provided answers to the amount of industrial waste generated are given, along with the total number of employees at all factories in the study area.

Table 3-25: Number of Employees from Responding Factories and All Factories in Study Area

Factory Code	Factory survey		All factories in study area		Rate (C=A/B x 100)
	Number of Factories	Number of Workers (A)	Number of Factories	Number of Workers (B)	
F01	5	2,127	15	2,975	71.5
F02	-	-	0	0	
F03	6	342	16	843	40.6
F04	60	22,269	121	37,765	59.0
F05	-	-	2	348	
F06	17	4,250	28	5,464	77.8
F07	18	3,651	47	6,003	60.8
F08	1	519	6	698	74.4
F09	2	208	5	445	46.7
F10	6	612	13	1,789	34.2
F11	-	-	3	133	
F12	3	253	13	538	47.0
F13	12	335	34	1,355	24.7
F14	18	5,555	75	9,625	57.7
F15	-	-	1	20	
F16	-	-	2	589	
F17	16	32,383	33	43,937	73.7
F18	-	-	6	440	
F19	6	1,458	20	3,225	45.2
Total	**170**	**73,962**	**440**	**116,192**	**63.7**

a.4 Tabulating the Amount of General Industrial Wastes Generated

Responses from 170 factories were used to estimate the total generation amount of general industrial waste, and divided into 4 major categories of waste, were then tabulated according to the 19 factory codes and different waste codes.

- General industrial waste generated from a Non-Production Process which is Non-Hazardous: Non-PP / Non-HIW
- General industrial waste generated from a Non-Production Process which is Hazardous: Non-PP / HIW
- General industrial waste generated from a Production Process which is Non-Hazardous: PP / Non-HIW
- General industrial waste generated from a Non-Production Process which is Non-Hazardous: PP / HIW

The Table 3-26 shows the tabulated results of general industrial waste from a non-production process which is non-hazardous (Non-PP / Non-HIW).

a.5 Generation Rate

Using the employees as the base, the generation rate (kg/year/employee), as mentioned above in the tabulation of generation amount for general industrial waste of 170 factories, was classified into 4 categories, 19 factory codes and general individual waste codes to calculate using Table 3-25: Number of Employees. Table 3-27 shows the generation rate for non-production process, non-hazardous wastes (Non-PP / Non-HIW).

As for the generation rate of the factory code, of which rate this survey could not get, the average generation rate for factory code obtained from all factories was applied.

a.6 Generation Amount

The generation amount of industrial wastes from PIM/MFZ was calculated by multiplying the number of employees from each factory code by the above mentioned generation rate from general industrial wastes generated. The resulting estimation of industrial waste generated from PIM/MFZ is as follows. The details are given in Table 3-28.

1. Non-PP / Non-HIW:	61,479.0 ton/year, or	168.4 ton/day
2. Non-PP / HIW:	13,970.0 ton/year, or	38.3 ton/day
3. PP / Non-HIW:	110,751.6 ton/year, or	303.4 ton/day
4. PP / HIW:	29,724.9 ton/year, or	81.4 ton/day
Total	**215,925.5 ton/year,**	**591.5 ton/day**

This generation amount does not greatly conflict with the tabulated results from the SUFRAMA waste inventory.

Table 3-26: Tabulation of Responses for General Industrial Waste Generation Amount (Non-PP / Non-HIW) of 170 Factories Surveyed

Non-Production Process – Non HIW (Unit : ton/year)														
Factory code	NH01	NH02	NH03	NH04	NH05	NH06	NH07	NH08	NH09	NH10	NH11	NH12	NH!3	Total
F01	82.6	1,039.0	226.0	81.0	7.0				-	921.0	59.0	233.0	222.0	2,870.6
F02														
F03	3.7		4.3	0.9	0.1	0.1			2.2				17.5	28.8
F04	1,570.7	1,192.3	3,648.6	581.2	3.6	17.5			337.1	83.4	28.7	67.7	3,390.9	10,921.7
F05														
F06	187.1	556.5	832.6	131.8	166.0				23.0	0.8	12.0		458.4	2,368.2
F07	224.1	44.0	769.0	201.2		0.7			243.6	820.6			417.3	2,720.5
F08		57.9	2.6	9.9	4.5					0.4			20.2	95.5
F09														
F10	1,128.1	227.7	60.1	44.2		0.3			5,412.3				153.9	7,026.6
F11														
F12			0.1										-	0.1
F13	18.0		5.7	5.3					0.1	-		0.6	14.9	44.6
F14	101.4	254.4	593.8	24.4		3.3			96.7	3.0		39.0	501.1	1,617.1
F15														
F16														
F17	1,605.4	23.5	428.8	406.1	2.0	0.3	0.1			0.1	29.4		1,952.3	4,448.0
F18														
F19	27.0		55.9	140.2	38.0	2.0							102.4	365.5
Total	4,948.1	3,395.3	6,627.5	1,626.2	221.2	24.2	0.1	-	6,115.0	1,829.3	129.1	340.3	7,250.9	32,507.2

Table 3-27: General Industrial Waste Generation Rate (Non-PP / Non-HIW)

Generation rate (Non-Production Process – Non HIW) (Unit: kg/year/person)														
Factory code	NH01	NH02	NH03	NH04	NH05	NH06	NH07	NH08	NH09	NH10	NH11	NH12	NH13	Total
F01	38.8	488.5	106.3	38.1	3.3				0.0	433.0	27.7	109.5	104.4	1,349.6
F02	---	---	---	---	---	---	---	---	---	---	---	---	---	---
F03	10.8		12.6	2.6	0.3	0.3			6.4				51.2	84.2
F04	70.5	53.5	163.8	26.1	0.2	0.8			15.1	3.7	1.3	3.0	152.3	490.3
F05*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F06	44.0	130.9	195.9	31.0	39.1				5.4	0.2	2.8		107.9	557.2
F07	61.4	12.1	210.6	55.1					66.7	224.8			114.3	745.0
F08	0.0	111.6	5.0	19.1	8.7					0.8			38.9	184.1
F09*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F10	1,843.3	372.1	98.2	72.2		0.5			8,843.6				251.5	11,481.4
F11*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F12*1			0.4										0.0	0.4
F13	53.7		17.0	15.8					0.3	0.0		1.8	44.5	133.1
F14	18.3	45.8	106.9	4.4		0.6			17.4	0.5		7.0	90.2	291.1
F15*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F16*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F17	49.6	0.7	13.2	12.5	0.1	0.0	0.0			0.0	0.9		60.3	137.3
F18*1	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4
F19	18.5		38.3	96.2	26.1	1.4							70.2	250.7
Avg. rate: 170 factories	66.9	45.9	89.6	22.0	3.0	0.3	0.0		82.7	24.7	1.7	4.6	98.0	439.4

Note: *1: There are few factories with this factory code, so it was not possible in this study to obtain the generation rate for the amount generated from the Non-PP / Non-HIW category of waste in this table. Therefore, generation rate of these factory codes are calculated by dividing A (total generation amount of each 13 category of waste) by B (number of employees of 170 factories which gave the answers). Also, some items show 0.0 even though there were generation amounts reported, but the generation rate was so small that it is shown as 0.0.

Table 3-28: Amount of General Industrial Waste Generated from PIM/MFZ

Unit: ton/year

Factory Code	Non production process		Production process		Total
	Non-HIW	HIW	Non-HIW	HIW	
F01	4,015.0	56.5	332.6	62.8	4,466.9
F02	-	-	-	-	-
F03	71.1	5.4	1,421.4	757.9	2,255.8
F04	18,516.2	3,274.3	34,396.2	7,383.1	63,569.8
F05	153.0	38.9	308.2	91.2	591.3
F06	3,044.5	1,247.4	9,286.0	1,327.3	14,905.2
F07	4,472.2	848.4	17,887.8	1,245.6	24,454.0
F08	128.6	1.2	587.3	2.2	719.3
F09	195.5	49.9	32.1	109.1	386.6
F10	20,540.3	125.1	8,957.0	801.8	30,424.2
F11	58.3	14.9	118.0	34.8	226.0
F12	0.2	60.4	7,599.5	129.7	7,789.8
F13	180.3	1.2	1,475.9	135.4	1,792.8
F14	2,801.9	7,506.9	4,475.7	688.2	15,472.7
F15	8.8	2.2	17.6	5.2	33.8
F16	258.8	66.0	521.8	154.7	1,001.3
F17	6,032.6	606.3	20,712.0	15,975.3	43,326.2
F18	193.2	49.3	389.8	115.6	747.9
F19	808.5	2.6	2,232.7	705.0	3,748.8
Total	61,479.0	13,956.9	110,751.6	29,724.9	215,912.4
ton/day	168.4	38.3	303.4	81.4	591.5

b. Flowcharts of General Industrial Waste Management

The waste streams for seven types of general industrial waste are given below for:

1. All industrial wastes generated from PIM — Figure 3-3
2. Non-HIW generated from PIM — Figure 3-4
3. HIW generated from PIM — Figure 3-5
4. Non-Production Process, Non-Hazardous Industrial Waste: — Figure 3-6
5. Non-Production Process, Hazardous Industrial Waste: — Figure 3-7
6. Production Process, Non-Hazardous Industrial Waste: — Figure 3-8
7. Production Process, Hazardous Industrial Waste: — Figure 3-9

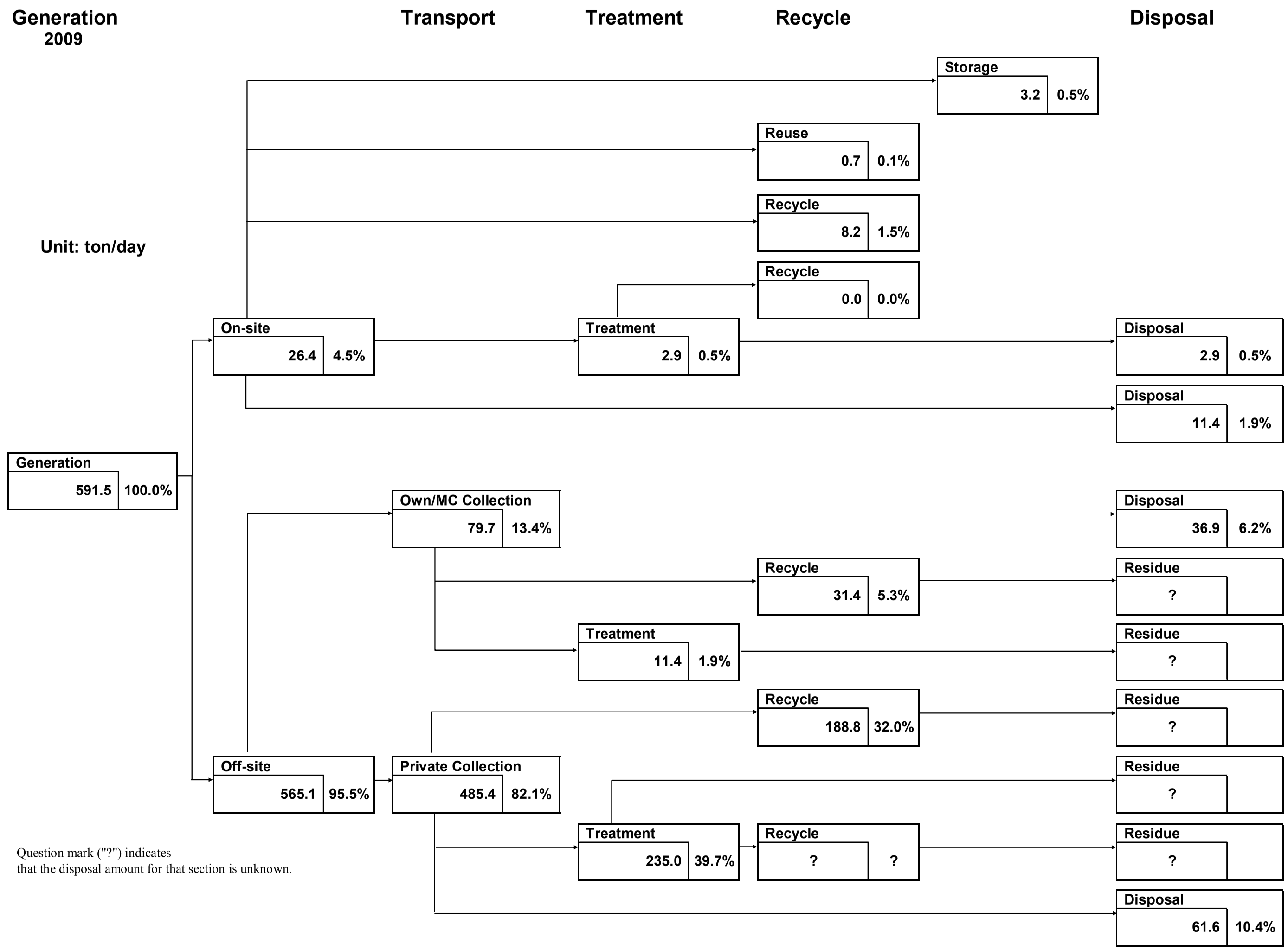


Figure 3-3: Waste Stream for all General industrial wastes generated from PIM

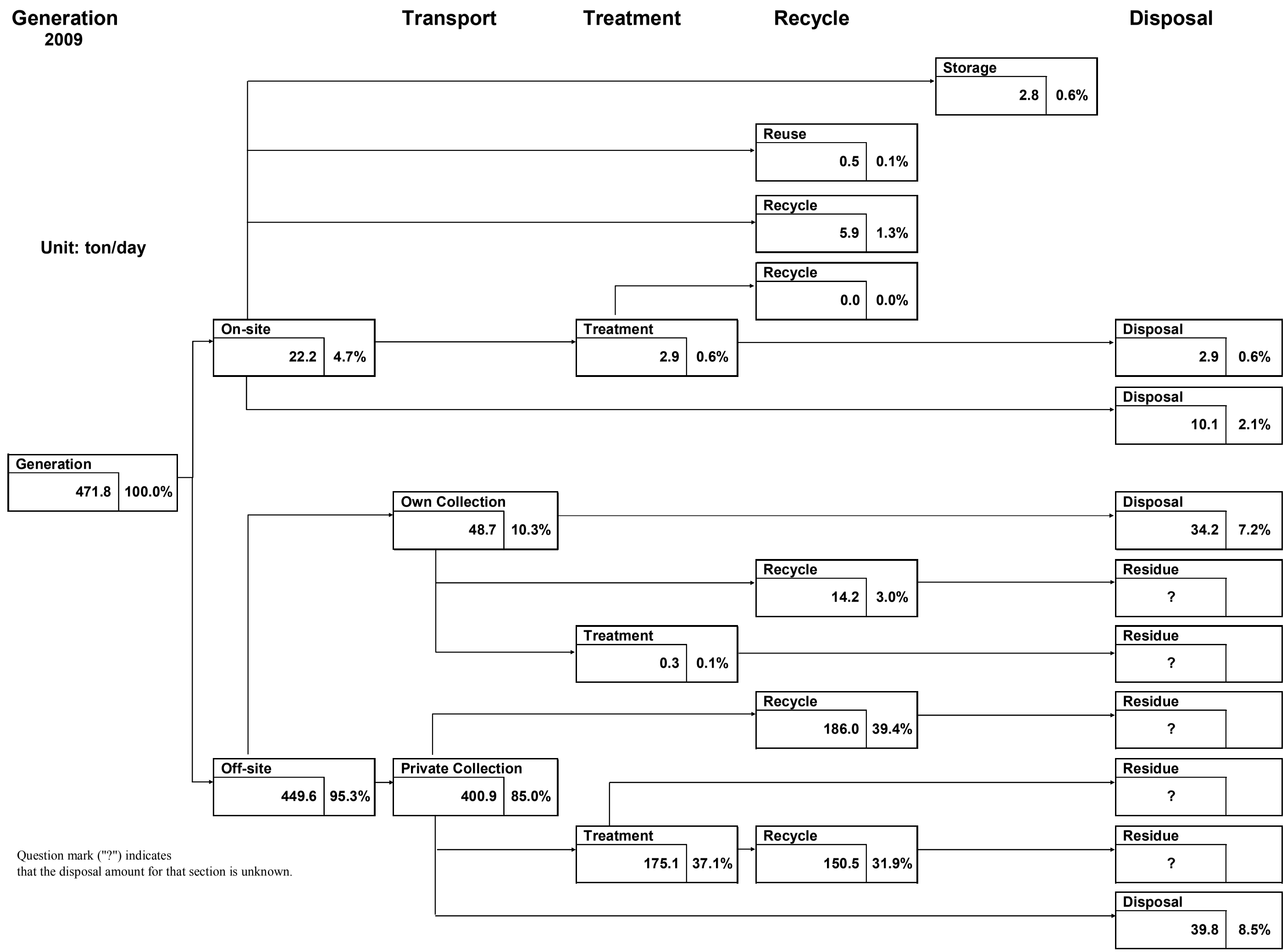


Figure 3-4: Waste Stream for General Non-HIW generated from PIM

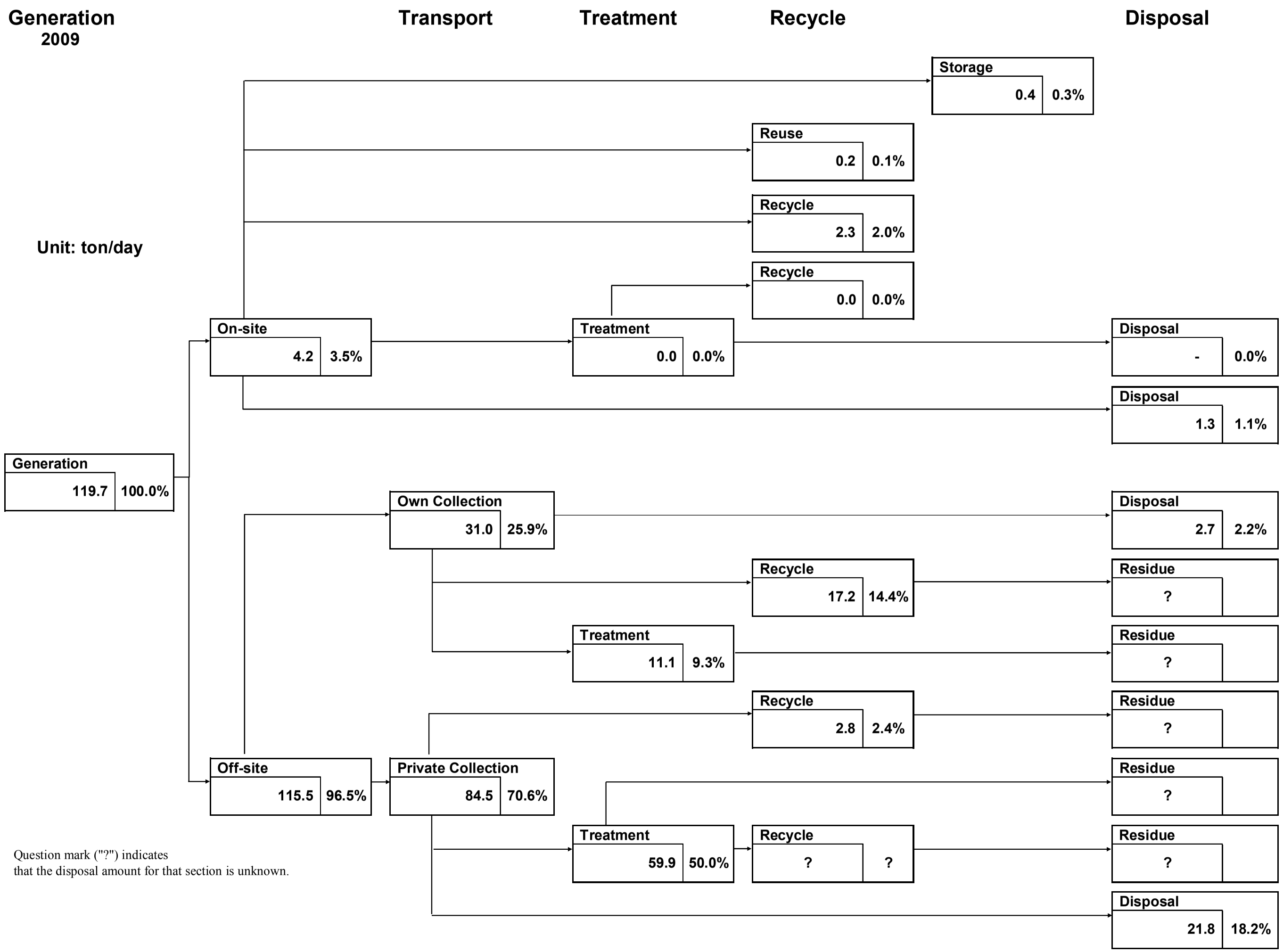


Figure 3-5: Waste Stream for General HIW generated from PIM

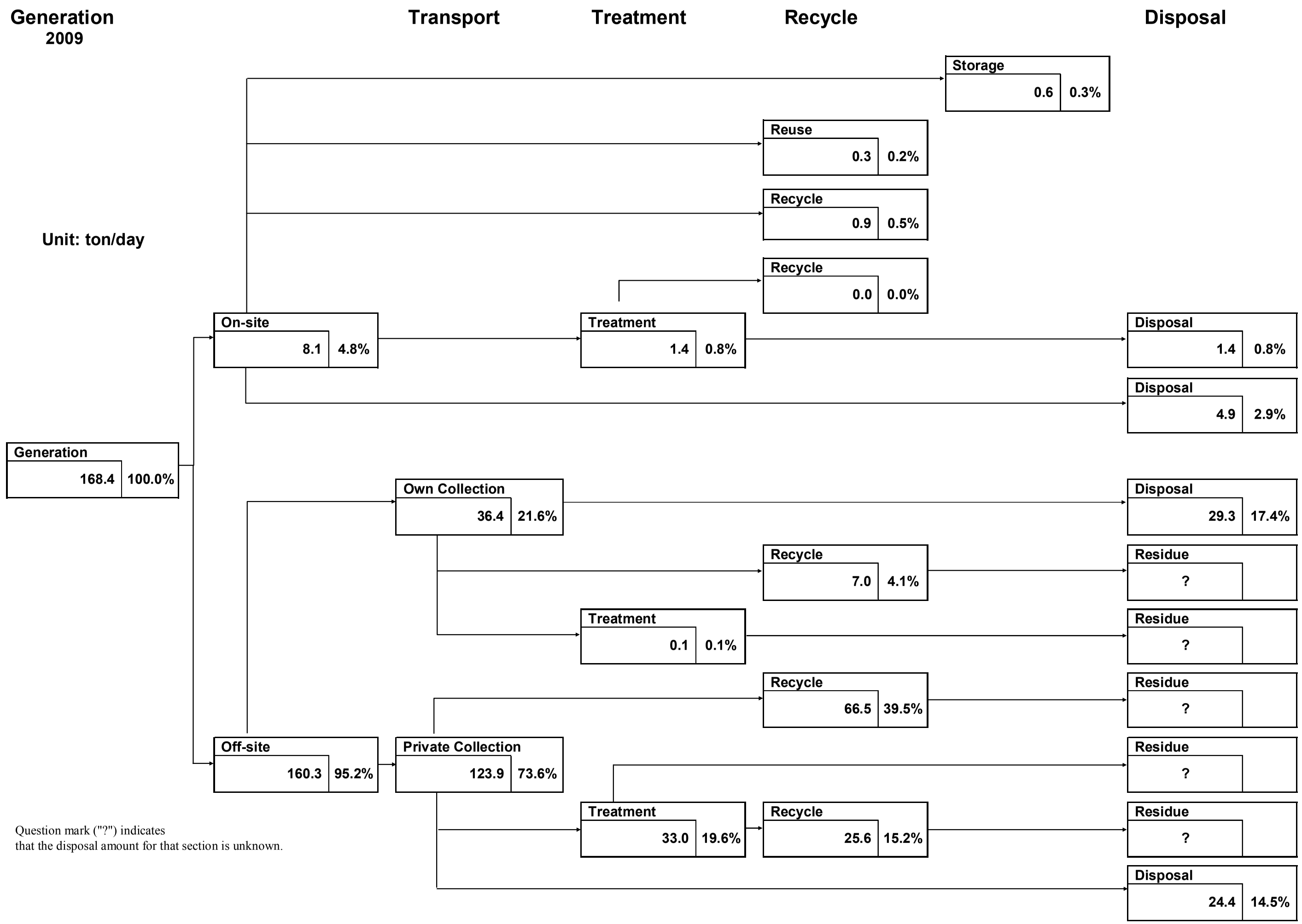


Figure 3-6: General Industrial Waste Stream (Non production process – Non HIW)

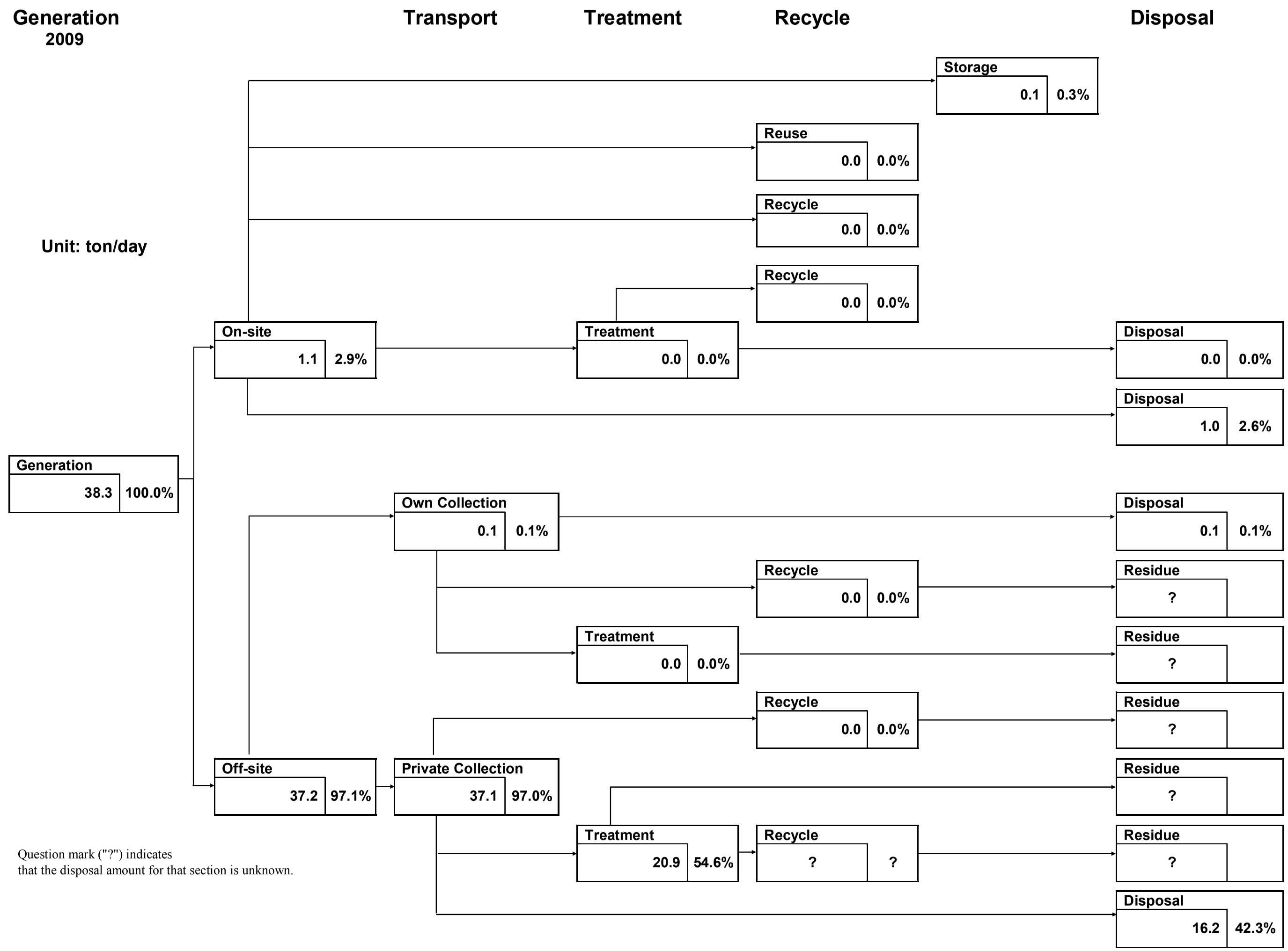


Figure 3-7: General Industrial Waste Stream (Non production process – HIW)

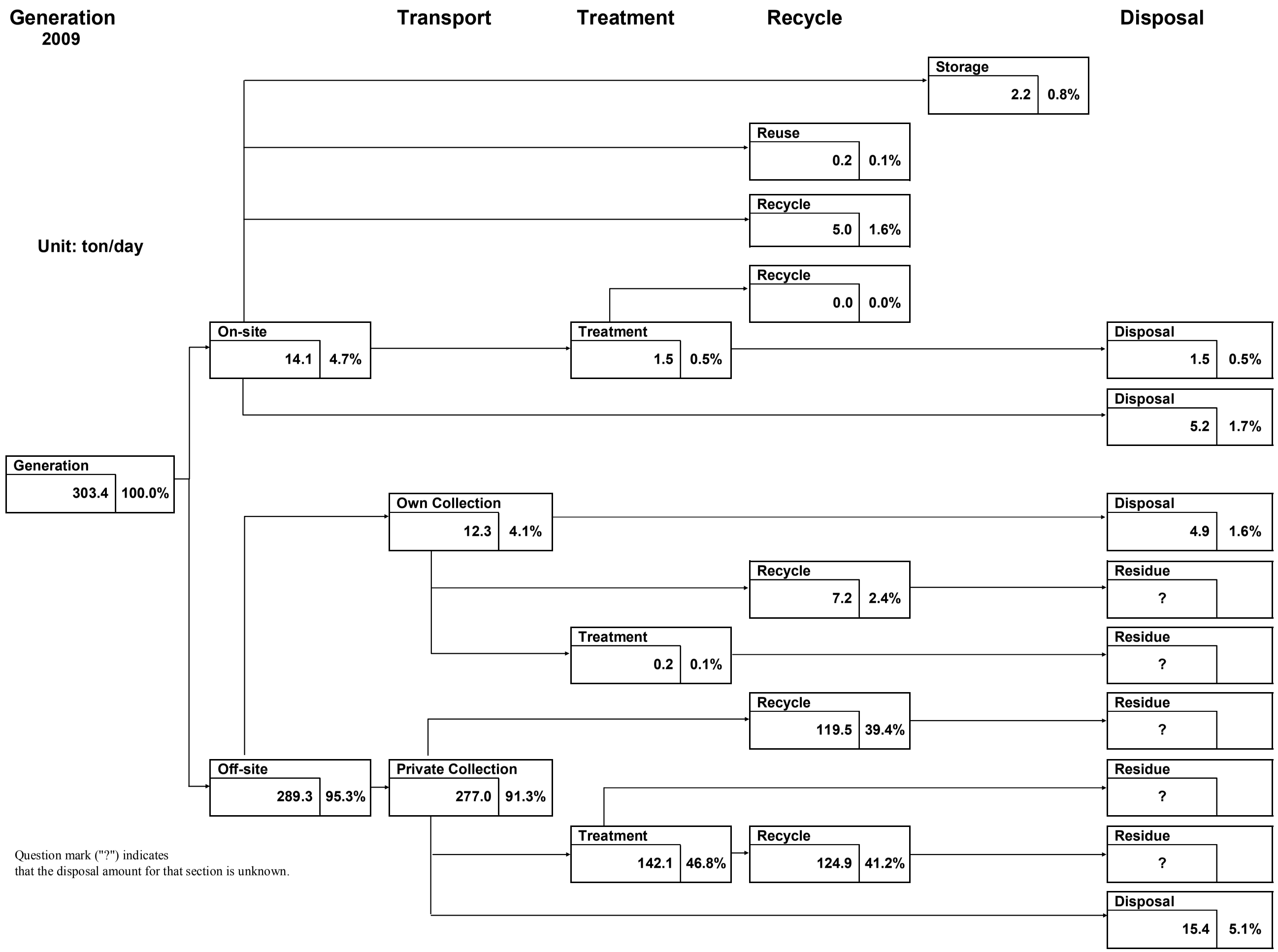


Figure 3-8: General Industrial Waste Stream (Production process – Non HIW)

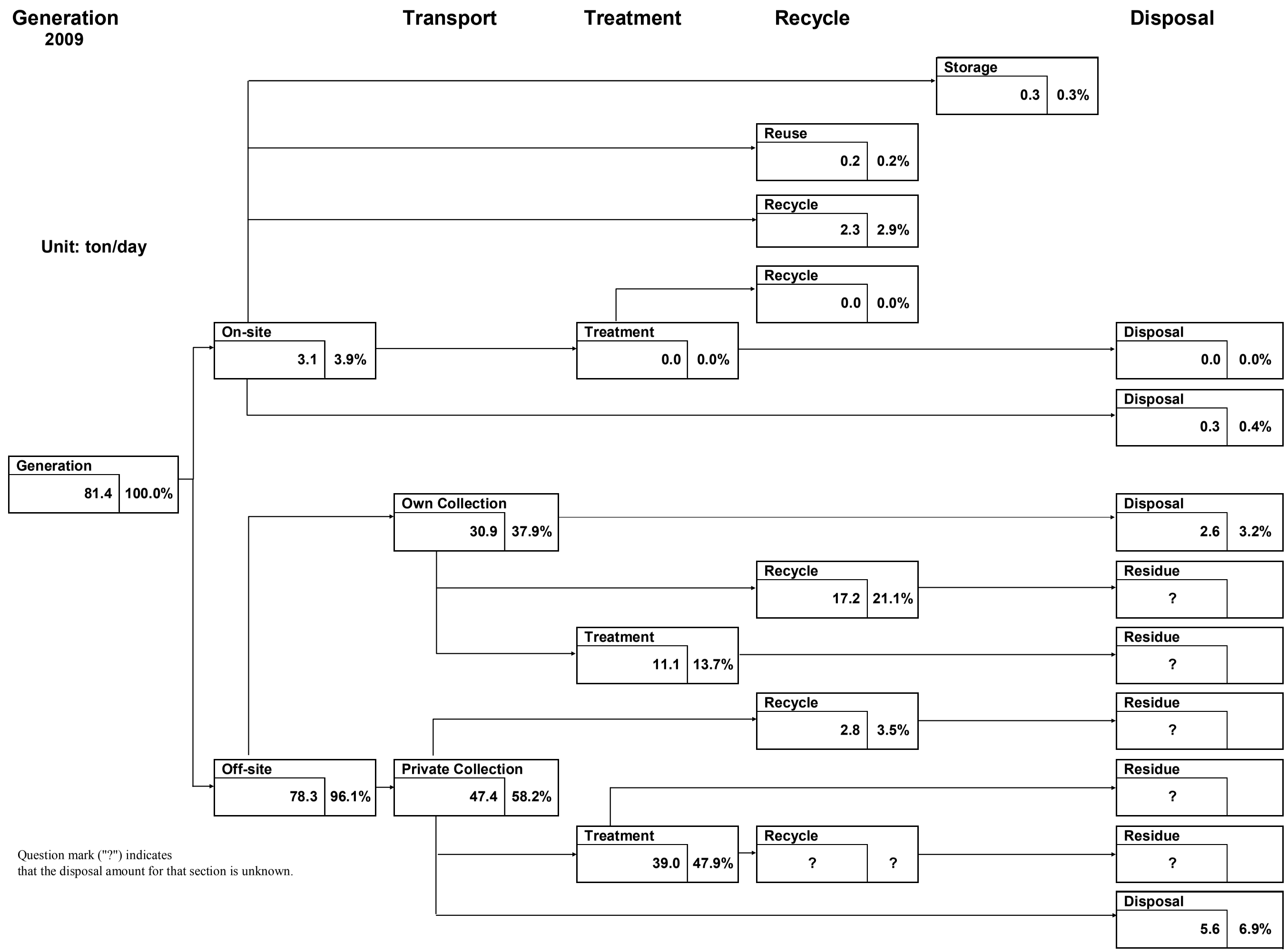


Figure 3-9: General Industrial Waste Stream (Production process – HIW)

c. Overview of PIM/MFZ Factories

c.1 General Conditions

The following general observations can be made given the survey results of 187 factories.

- 62.0 % of the factories (i.e. 116 of 187) are relatively new, having begun operations sometime since 1991.
- The average lot size (159 factories) and construction area (154 factories) was 55,800 sq meters and 15,300 sq meters, respectively.
- The total number of employees from all responding factories (187 factories) is 58,470, giving an average of 350.

c.2 Attached Medical Facilities (Clinics)

44.3 % of the factories (i.e. 78 of 176) have clinics attached. This is the result of the medical institution survey of 334 factories where 37.1% factories (i.e. 124 of 334) replied that they have medical facilities within the factory.

c.3 Radioactive Waste

Of all respondents, none of the factories indicated generation of radioactive waste. This fits in the result of responses from 7 factories surveyed in the radioactive waste survey.

c.4 Use of Pollution Control Facilities

The following table gives the responses of the use of pollution control facilities.

Table 3-29: Use of Pollution Control Facilities

Pollution control facilities	Valid answer (A)	1. Yes (B)	% (B/Ax100)
a. Boiler	172	22	12.8
b. Incinerator	171	3	1.8
c. Industrial wastewater treatment facilities	171	47	27.5
d. Domestic wastewater treatment facilities	175	95	54.3
e. Dust collector	172	20	11.6
f. Air control facilities	169	21	12.4
g. Plating process	168	5	3.0
h. Powder Painting process	170	15	8.8
i. Water Painting process	170	22	12.9
j. Metal coating process	173	13	7.5
k. Storage space of Dangerous substance (Underground: Oils, Volatile substance, etc.)	145	29	20.0
l. Storage space of Dangerous substance (Above surface: Oils, Volatile substance, etc.)	167	96	57.5

The table above gives the following results.

- The rate of industrial wastewater (effluent) treatment facilities installed is somewhat low at 27.5 %. However, this rate should be qualified for those cases where industrial wastewater treatment is necessary and evaluated after a study of the production processes at the plant, etc.
- On the other hand, the rate of treatment facilities installed for domestic wastewater

from non-production processes is 54.3 %, which is relatively high in comparison to that for industrial wastewater facilities. Nevertheless, a Manaus City regulation (Law No. 1,192/2007) established 31 December 2007, requires the installation of domestic wastewater treatment facilities for enterprises that have at least 40 employees. Even with a one-year grace period, this will obligate over half of factories to install facilities from 2009.

d. On-Site Waste Management

d.1 Waste Inventory

In response to the question of whether it was required to submit a waste inventory, 27.5 % (i.e. 49 of 178 factories) responded that it was not. Of those factories that responded that it is required (i.e. 129 of 178), 11.6 % (i.e. 15 of the 129) responded that they had not submitted a waste inventory. Therefore, despite the requirement for all factories to submit a waste inventory, 36.0 % of factories surveyed (i.e. 64 of 178) said that they do not. This data indicates that there is a lack of awareness at factories concerning waste management.

d.2 Separation

86.0 % of factories (i.e. 154 of 179) separate their non-production process waste from their production process waste before discharge.

In relation, 18.8 % of factories (i.e. 33 of 176) reported that they mix their non-HIW and HIW for discharge. The reasons for this were given in the following order:

1. The amount is extremely small – 41.9 % (13 of 31 respondents)
2. Difficulties to separate PP / HIW and PP / Non-HIW – 12.9 % (4 of 31 respondents)
3. Collection service does not require the separation of HIW and Non-HIW – 9.7 % (3 of 31 respondents)

d.3 Ratio of On-Site and Off-Site Management

The following table clearly shows that the ratio of on-site management in PIM is extremely low at 4.5 %. Furthermore, the difference between non-hazardous industrial waste and hazardous industrial waste is practically negligent.

Table 3-30: Ratio of On-Site and Off-Site Management

Study Area	Waste	Ratio of On-Site Disposal	Ratio of Off-Site Disposal
PIM	Industrial Waste	4.5 %	95.5 %
	Non-HIW	4.7 %	95.3 %
	HIW	3.5 %	96.5 %
Bangkok Metropolitan Area[*1]	Non-HIW	29.9%	70.1%
	HIW	56.3%	43.7%

Source *1: The Study on Master Plan on Industrial Waste Management in the Bangkok Metropolitan Area and its Vicinity in the Kingdom of Thailand, November 2002 (Hereafter, Bangkok Industrial Waste Study)

d.4 Type of On-Site Management

The following table shows a comparison of types of on-site management at PIM factories.

Table 3-31: Type of On-Site Management

Study Area	Waste	Intermediate Treatment Ratio	Reuse and Recycle Ratio	Storage Ratio	Final Disposal Ratio
PIM	Industrial Waste	0.5 %	1.6 %	0.5 %	1.9 (2.4*2)%
	Non-HIW	0.6 %	1.4 %	0.6 %	2.1 (2.7*2)%
	HIW	0.0 %	2.1 %	0.3 %	1.1 %
Bangkok Metropolitan Area*1	Non-HIW	0.9%	13.1%	1.8%	14.1%
	HIW	32.8%	1.6%	0.4%	21.5%

Source *1: Bangkok Industrial Waste Study

Note *2: This ratio includes residue disposed after intermediate treatment

There is almost no difference between on-site management in PIM (ratio of quantitative generation rate) of non-hazardous industrial waste and hazardous industrial waste.

In comparison, the Bangkok study results show high prominence between non-HIW and HIW due to the high cost of off-site management, they reduce HIW by treating HIW as much as possible on-site (32.8% of the quantitative generation rate). In addition, Non-HIW was reused or recycled as much as possible (13.1% of the quantitative generation rate).

d.5 On-Site Final Disposal

The detailed descriptions of this in descending order are: hazardous wastes are sludge, contaminated plastics and ink residue. In addition, fluorescent lights and batteries were also reported, but done so individually so the weight is unknown. Reports for non-hazardous, in descending order, are cardboard, non-recyclable wastes, and plastic lids. The results suggest these items are for storage waiting for off-site management.

e. Off-Site Waste Management

Below are the responses from dischargers of waste concerning the conditions of off-site waste management. These must be analyzed in comparison with responses from waste service companies.

e.1 Collection

The following table shows the breakdown of the ratio of the amount of waste discharged from factories which is collected and transported by collection service providers.

Table 3-32: Breakdown of Collection Service Providers

Study Area	Waste	Factory (City) Ratio and Amount*2		Ratio of Private Enterprise and Amount	
		Ratio	Ton/Day	Ratio	Ton/Day
PIM	Industrial Waste	13.4 %	79.7	82.1 %	485.4
	Non-HIW	10.3 %	48.7	85.0 %	400.9
	HIW	9.3 %	31.0	70.6 %	84.5
Bangkok Metropolitan Area *1	Non-HIW	1.5%	95.8	68.6%	4,444.5
	HIW	0.1%	1.9	43.6%	665.4

Source *1: Bangkok Industrial Waste Study

Note *2: In PIM, only a very small amount is collected by the city (0.4%). In contrast, 100% was collected by the city in the Bangkok Industrial Waste Study.

From this table it is possible to see the distinct difference between Non-HIW and HIW where most of Non-HIW is collected by private enterprise (WSCs). In contrast, a large amount of HIW is transported by the factory itself. In the Bangkok study, the factory itself transported almost none.

e.2 Breakdown of Off-Site Management

The following table shows the breakdown (generation ratio) of off-site management based on answers from PIM factories.

Table 3-33: Breakdown of Off-Site Management

Target Area	Waste	Intermediate Treatment Ratio and Amount		Reuse and Recycling Ratio and Amount		Direct Final Disposal Ratio and Amount	
		Ratio	Ton/Day	Ratio	Ton/Day	Ratio	Ton/Day
PIM	Industrial Waste	41.6 %	246.4	37.3 %	220.2	16.6 %	98.5
	Non-HIW	37.2 %	175.4	42.4 %	200.2	15.7 %	74.0
	HIW	59.3 %	71.0	16.8 %	20.0	28.4 %	24.5
Bangkok Metropolitan Area *1	Non-HIW	2.5%	159.5	64.8%	4,198.8	2.8%	95.8
	HIW	28.9%	444.1	14.2%	216.1	0.6%	1.9

Source *1: Bangkok Industrial Waste Study

There is some difference between the off-site management (proportion of generation ratio) in PIM of Non-HIW and HIW. It is reasonable that rate of treatment of HIW is higher than Non-HIW and it of reuse/recycle of HIW is much lower than Non-HIW. It is, however, the rate of direct final disposal of HIW is two times more than it of Non-HIW. It is a serious issue that rate of direct final disposal of HIW is quite high, 28.4%.

In comparison, the findings from Bangkok show a very noticeable difference between the HIW and Non-HIW, where most of the Non-HIW discharged off-site (generation ratio of 64.8%) is reused or recycled. In contrast, much of the hazardous waste is put through intermediate treatment (28.9% of the generation ratio) in an attempt to render it harmless or reduce the amount. In addition, the rate of direct final disposal of industrial waste is much lower than it in PIM, 0.6% for HIW and 2.8% for Non-HIW, especially HIW. In addition, the amount of residue after intermediate treatment and recycling could not be identified.

f. Plans and Intentions

f.1 Future Generation Amount of Industrial Waste

Respondents stated that future generation amounts would: remain at the current amount (31.8 %, or 54 of 170 factories); increase (37.6 %, or 64 of 170 factories); or reduce (21.2 %, 36 of 170 factories). Given these responses, it is likely that the generation amount will increase slightly in the future.

f.2 Plans to Promote 3R and IWM Improvement Plans

Most factories have no plans to promote 3R (70.2 %, or 120 of 171 factories). Also, the majority of factories have no intention to formulate an industrial waste management improvement plan (78.8 %, or 134 or 170 factories).

f.3 Waste Exchange

The majority of factories had some knowledge of waste exchange (73.4 %, or 127 of 173 factories). Presently, 36.2 % (i.e. 63 of 174) of factories are engaged in waste exchange, but there was a high rate of 67.8 % (i.e. 116 of 171) of those factories with an interest in this.

f.4 Disposal Fee

Payment to transporters of discharged industrial waste was indicated by 60 respondents at R$ 563,000 annually on average. On the other hand, the on-site waste management fee indicated by 20 respondents was R$ 769,000 annually on average.

f.5 Problems with Industrial Waste Management

62.6 % (i.e. 109 of 174 factories) said there were currently problems with industrial waste management. The reasons given are as follows, in descending order.

1. High cost of industrial waste disposal: 57.8 % (63 of 109 respondents)
2. No facilities, or insufficient facilities, for the reuse or recycling of industrial waste: 48.6 % (53 of 109 respondents)
3. No service, or insufficient service, for industrial waste treatment: 37.6 % (41 of 109 respondents)
4. No trustworthy treatment and disposal contractors in Manaus: 34.9 % (38 of 109 respondents)

3.4 Study of Health-care Waste Management in Medical Institutions

3.4.1 Outline of the Study

a. Study Objective

The study aims to clarify the current conditions of health-care waste management at generation sources in the PIM by visiting those hospitals (one location) and clinics on factory premises (nine locations) and conducting direct interviews to survey the types of waste generated, amount discharged and conditions of health-care waste management, etc.

b. Study Method

A local consultant (OPCA) was consigned to conduct the study. The local consultant visited and conducted interviews with medical institutions using a questionnaire form made by the study team.

The study team produced a draft of the questionnaire form to use as the basis for discussion with the C/P, and then revisions were made based on that discussion. The following items were included in the questionnaire:

Table 3-34: Content of the Medical Institution Survey

1. Basic Items	2. Current Waste Management	3. Comment/Notes
• Location of Medical Institution • Medical Services Provided • No. of Employees • No. of Beds • Number of Inpatients/Outpatients • Others	The following items are surveyed, making a division between infectious/hazardous waste and common waste. • Generation amount • Separation at Source • Storage Methods and Containers Used • Discharge Methods and Containers Used • Treatment Methods (e.g. Incineration, Sterilization), if any, and other Methods • Contracted Collection Company and Collection Method • Location and Methods of Disposal • Others	• Management system of infectious/hazardous waste • Knowledge of an implementation of regulations for health-care waste management • Reporting on infectious/hazardous waste management conditions, if any, and who is reported to. • Education, if any, and methods for employees to handle infectious/hazardous waste • Fees for Collection, Treatment, Disposal of infectious/hazardous waste • Awareness of environmental consideration • Others

3.4.2 Health-care Waste Categories

a. ABNT NBR 12808 (1993) and RDC 306/2004-ANVISA

Health-care waste (i.e. Health Service Waste) is regulated by the Brazilian Association of Technical Standards (ABNT) NBR 12808 and the National Health Surveillance Agency (ANVISA). Handling health-care waste is prescribed by both the ABNT NBR 12809 and the RDC 306/2004-ANVISA.

In this study the questionnaire for the medical institutions survey has been prepared based on the health-care waste categories described in the ABNT NBR 12809 and the survey was conducted using the questionnaire. After the questionnaire survey was completed, it was pointed out that the RDC 306/2004-ANVISA is being used at present. The results of the survey were, therefore, converted into the health-care waste categories described in the RDC

306/2004-ANVISA. The following table shows conversion of health-care waste categories of the RDC 306/2004-ANVISA and the ABNT NBR 12809.

Table 3-35: Conversion of Health-care Waste Categories between

RDC 306/2004-ANVISA			ABNT NBR 12809	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

b. Health-care Waste Categories used in the Study

In this study, health-care waste was divided into five large groups according to RDC 306/2004-ANVISA. The details of each group are explained in the Supporting Report Chapter 2.

3.4.3 Selection of Target Medical Institutions

There are 475 factories in the factory list provided by SUFRAMA, and of those, 18 factories are located outside the target area, the MFZ. A total of 457 PIM factories in the MFZ area were contacted to confirm whether they had an attached clinic. The following results were found according to their responses.

- Factories that responded by telephone: 334
- Factories that have closed: 17
- Factories that refused to reply: 25
- Factories that could not be reached by telephone: 81

In this survey, it was revealed that 440 factories are PIM factories operating in the MFZ, including those which could not be reached by telephone (which was likely due to a changed phone number, etc.) and excluding the 17 which have closed.

It was found that at least 1/3 of the total (35.3%), or 124 factories, have an attached clinic. Of those 124, nine within the PIM were chosen for direct interview using the prepared survey questionnaire. A summary of these medical facilities, including one general hospital in the PIM, is given below.

Table 3-36: Summary of Medical Facilities

Type	No. Surveyed	No. of Employees*1	No. of Beds	Avg No. of Inpatients/Day	Avg No. of Outpatients/Day
General Hospital	1	439	70	48	900 (*3)
Attached factory clinic	9	4.1 (*2)	1.2 (*2)	No reply	19 (*2)

Notes *1: Including part-time employees

*2: Average of 9 clinics

*3: Of this number, 22 were emergency room outpatients

3.4.4 Execution of the Survey

A local consultant (OPCA) was consigned to conduct the study on 19 June 2009. Immediately after the contract was signed, the local consultant contacted all PIM factories approved by SUFRAMA by telephone, etc., and inquired about the existence of a clinic on premises, then selected the target medical facilities before beginning the direct interview process. Finally, working with the study team, the survey results were compiled by the end of August. The interview survey and summary of results was completed by the end of July, as planned, and the results were analyzed together with the study team in August before being summarized into a report.

Although questionnaire survey and analysis of the survey results were done base on the waste categories of ABNT NBR 12809, those have been revised based on the waste categories the designated by the RDC 306/2004-ANVISA.

3.4.5 Results of the Survey

a. Results of Waste Amount, Generation Rate and Waste Streams

a.1 Generation Amount of Health-care Waste in ABNT NBR 12809 Category

The generation amount of health-care waste in ABNT NBR 12809 Category for the 10 medical institutions is given below.

Table 3-37: Amount of Health-care Waste (in ABNT NBR 12809 Category) Generated by Target Medical Institutions

Unit: kg/day

Category of Health-care Waste	General Hospital	Clinics (*1)
Class A: Infectious Waste	**26.16**	**0.96**
A.1. Infectious waste	4.19	0.16
A.2. Blood and derivates	1.83	0.01
A.3 Surgical, anatomo-pathologic and exudates	8.11	0.10
A.4 Piercing or cutting	3.40	0.43
A.5 Contaminated animal	---	---
A.6 Patient care	8.63	0.26
Class B: Special Waste	**1.67**	**0.27**

B.1 Radioactive waste	---	---
B.2 Pharmaceutical waste	1.00	0.11
B.3 Hazardous chemical waste	0.67	0.16
Total of Class A and B (Hazardous Waste)	**27.83**	**1.22**
Class C: Common Waste	**94.0**	**1.17 (*2)**
Total	**121.83**	**2.40**

Note *1: Average number for 9 clinics

*2: This number is less than the amount of hazardous health-care waste generated. The reason being that it is discharged as non-process, non-hazardous waste from another place within the factory, and the clinic does not that this discharge into consideration. One clinic did not respond.

a.2 Generation Amount of Health-care Waste in RDC 306/2004-ANVISA Category

The generation amount of health-care waste in RDC 306/2004-ANVISA Category for the 10 medical institutions is given below.

Table 3-38: Amount of Health-care Waste (in RDC 306/2004-ANVISA Category) Generated by Target Medical Institutions

Unit: kg/day

Category of Health-care Waste	General Hospital	Clinics
Group A	**22.76**	**0.52**
A.1. Biologic	6.01	0.16
A.2. Animals	---	---
A.3 Body part	8.11	0.10
A.4 Patient care etc.	8.64	0.26
A.5 Prions	---	---
Group B: Chemical etc.	**1.67**	**0.27**
Group C: Radioactive	**---**	**---**
Group E: Piercing or Cutting	**3.40**	**0.44**
Total of Group A, B, C and E (Hazardous Waste)	**27.83**	**1.22**
Group D: Common waste	**94.00**	**1.17**
Total	**121.83**	**2.40**

a.3 Number of Factories with a Clinic

124 factories of 334 surveyed have a clinic within their compound. It is estimated 163 (= 124 x 440/334) factories have a clinic in PIM in total.

a.4 Generation Rate and Amount of Health-care Waste Generated from Factories in PIM

As 163 factories have a clinic in PIM in total, the generation amount of health-care waste generated from factories in PIM and generation rate per an employee is calculated as follows:

Generation Amount of Factories in PIM = Generation Rate per a Clinic x 163

Generation Rate per an Employee = Generation Amount of Factories in PIM / Number of Employees in PIM (116,192)

Table 3-39: Generation Rate and Amount of Health-care Waste Generated from Factories in PIM

Group		Description	Generation Rate per a Clinic (kg/clinic/day)	Generation Amount of Factories in PIM (kg/day)	Generation Rate per an Employee (g/employee/day)
1.Group A	A.1	Biologic	0.16	26.1	0.22
	A.2	Animals	0.00	0.00	0.00
	A.3	Body part	0.10	16.3	0.14
	A.4	Patient care etc.	0.26	42.4	0.36
	A.5	Prions	---	---	---
2. Group B		Chemical etc.	0.27	44.1	0.38
3. Group C		Radioactive waste	0.00	0.00	0.00
4. Group E		Piercing or Cutting	0.44	71.9	0.62
Hazardous Health-care Waste Sub-total			1.23	200.8	1.73
5. Group D		Common waste	1.17	191.1	1.64
Total			2.40	391.9	3.36

The amount of health-care waste generated in PIM including a general hospital is shown in the table below.

Table 3-40: Amount of Health-care Waste Generated in PIM

Unit: kg/day

Category	Whole Factories in PIM (B x 440 /334) (kg/day)	General Hospital (kg/day)	Whole PIM (E = C + D) (kg/day)
Group A	84.8	22.7	107.5
Group B	44.0	1.7	45.7
Group C	0.0	0.0	0.00
Group E	71.7	3.4	75.1
Hazardous Health-care Waste Total	200.5	27.8	228.3
Class D	190.7	94.0	284.7
Health-care Waste Total	391.2	121.8	513.0

a.5 Health-care Waste Generation

Health-care waste generation from factories in PIM excluding a general hospital is as follows:

- Hazardous Health-care Waste: 200.5 kg/day
- Non-hazardous Health-care Waste: 190.7 kg/day
- Total Health-care Waste: 391.2 kg/day

Given the above information, the daily generation amount from the target area (PIM), including the one general hospital, of hazardous and non-hazardous health-care waste is estimated as follows:

- Hazardous Health-care Waste: 228.3 kg/day
- Non-hazardous Health-care Waste: 284.7 kg/day
- Total Health-care Waste: 513.0 kg/day

a.6 Present Health-care Waste Management Stream

The present health-care waste management stream in PIM, according to the survey of medical institutions, is shown in the following figures.

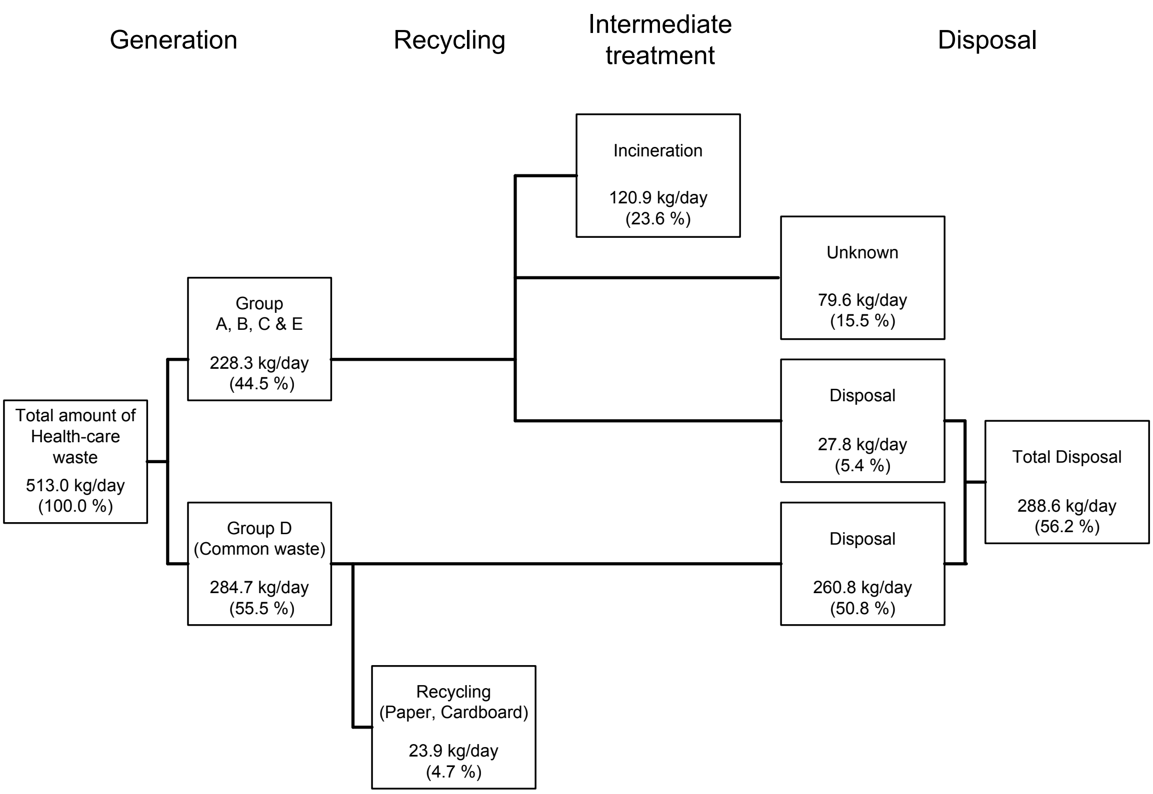


Figure 3-10: Health-care Waste Management Stream in PIM including General Hospital

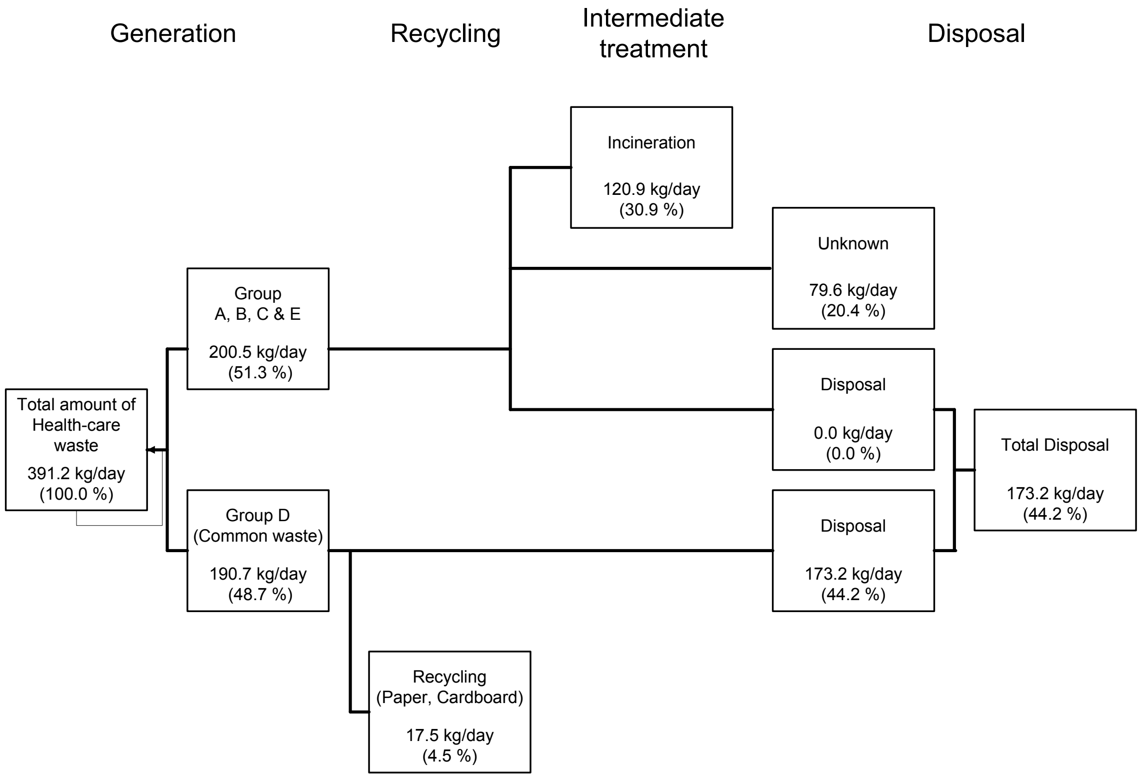


Figure 3-11: Health-care Waste Management Stream in PIM excluding General Hospital

b. On-Site Health-care Waste Management

b.1 Discharge Containers

RDC 306/2004-ANVISA regulates discharge containers according to different waste categories. The general hospital utilizes the categorization put forth in RDC 306/2004-ANVISA. For attached clinics at factories, the ratio which is observed is no more than half of this.

b.2 Storage

Of the facilities surveyed, one responded that the hazardous health-care waste and common waste they stored was mixed. Also, concerning storage containers, excluding Group E (e.g. needles, scalpels), the general hospital stores hazardous health-care waste in plastic bags inside a plastic container with lid. Waste is stored in covered containers at 61% of the clinics. Also, the hospital and one-third of the clinics used cardboard boxes to store Group E (needles, scalpels, etc.).

All of the facilities surveyed responded that that did not have cool storage facilities for certain Group A.3 (Body part) waste.

b.3 Intermediate Treatment and Disposal

Intermediate treatment and disposal is not carried out, with the exception of treatment of Group A.1 (Biologic) using an autoclave in the general hospital.

b.4 Recycling

Forty percent of the medical institutions, including the general hospital, recycle common waste valuables, such as paper and cardboard. Recyclers collect these valuables from each medical institution on a regular basis.

b.5 Discharge

Waste is discharged from attached clinics according to prescribed categories.

Hazardous health-care waste and non-hazardous health-care waste are not mixed when discharged. Nevertheless, even though Group A, B and E and each class type, are stored separately, 20% of the facilities reported mixed discharge; the medical institutions' employees are the likely reason for this.

b.6 Training and Instructions

All of the facilities reported having written instructions concerning the handling of hazardous health-care waste within the medical institution. Also, 100% said there is training/instruction for waste workers for handling hazardous health-care waste. Furthermore, 50% said that this training takes place once a year.

Employees at 80% of the medical institutions report receiving environmental educational training or information concerning hazardous health-care waste. At attached clinics, 242 people attend the classes on average.

b.7 Cooperation for Waste Management Improvements

All ten of the medical institutions surveyed replied that they are able to cooperate on waste management improvement. Concerning efforts they would be willing to make for improvements, all replied "raising the environmental awareness of the public", eight (8) replied they could "minimize waste generation" and seven (7) said through "discharging wastes neatly". Also, all replies confirmed that they would cooperate with national and municipal authorities toward waste management improvement.

b.8 Priority of Waste Management Improvements

A rise in waste management fees was indicated by 60% of medical institutions. 70% replied that waste management was a very high priority. Furthermore, 50% said they would welcome technical support from a government organization, whereas 30% were hopeful for financial support.

b.9 Intention to Improve Conditions for Collection and Disposal of Hazardous Health-care Waste

In order to improve the current conditions of collection and disposal of hazardous health-care waste, 3 (of 8 respondents) answered "education to change people's bad habits", and 2 (of 8) indicated "improvement of landfill operation".

Concerning who should bear the rise in cost for improvement of current collection and disposal conditions for hazardous health-care waste, respondents indicated the following: the State of Amazonas (30%), the City of Manaus (20%), and others (20%). Further, five facilities indicated that the greatest amount they would be willing to pay for collection and disposal was, on average, 145R$/month.

c. Off-Site Health-care Waste Management

c.1 Collection

All of the medical institutions (100%) receive collection service for both non-hazardous and hazardous health-care waste. With the exception of one institution which receives service from SEMMA/SEMULSP, all institutions receive collection service of hazardous waste from private companies. 40% of medical institutions, however, do not pay fee for hazardous health-care waste. 60% indicated that they set the collection fee, although it varied from place to place.

Despite the fact that 30% of medical institutions indicated dissatisfaction with current collection service, there were no complaints from medical institutions in the past year received by collection service providers.

c.2 Monitoring of Hazardous Health-care Waste Disposal

All of the medical institutions indicated that a person has been assigned to be in charge of appropriate collection and disposal of hazardous health-care waste.

c.3 Disposal of Hazardous Waste

The general hospital replied that its hazardous health-care waste was sent, according to waste category, to a prescribed location in a landfill, or other. In the case of attached clinics, two-thirds of respondents said that their waste went to an incinerator, whereas the remaining one-third provided no answer.

d. Issues on Health-care Waste Management

The following results were revealed in the survey of medical institutions.

d.1 Health-care Waste Management System Provisions

Over one-third (37.1%) of PIM factories have an attached medical clinic. These attached clinics are also equipped with beds where medical treatments can take place. For this reason, not only Group D: Common waste, but also Group A, B, C and E hazardous wastes are generated. The amount of hazardous health-care waste solely at attached clinics is estimated at 200.8 kilograms per day, and estimated at 228.6 kg/day when combined with the general hospital. The problem is that this amount of hazardous health-care waste is generated was not known. It is necessary, from here on, using these results as the basis, to prepare a management structure to grasp the actual conditions of health-care waste, and particularly hazardous health-care waste, to implement more appropriate methods.

d.2 On-Site Management

Appropriate waste management has been set to a certain level at medical institutions which produce health-care waste. Also, awareness of appropriate management is high. In particular, there are no identifiable problems at the general hospital, according to their response to the survey. However, the following problems were identified at the clinics.

- Less than half use the designated container for discharge set by RDC 306/2004-ANVISA
- Although hazardous health-care waste is stored according to Group A, B, C and E, mixed discharge takes place at two clinics (2 of 8 respondents).

d.3 Understanding Current Conditions of Off-Site Disposal

On the other hand, the replies from medical institutions concerning off-site waste management after discharge were insufficient to understand actual conditions. On this point, it may be inferred that the waste manifest system is insufficient, and responsibility of the discharger remains unclear for appropriate management after discharge.

Non-hazardous, Group D (common waste) is collected by Manaus City and disposed of in the city's landfill. Nevertheless, questions as to hazardous health-care waste were revealed, as follows.

1. Replies indicated that treatment and disposal of hazardous waste was outsourced; however, three medical institutions (of 9 respondents) were unable to elaborate on the actual conditions therein. The amount is 79.9 kg per day, which indicates 35% of the total generation amount of hazardous health-care waste.
2. Replies indicated that some hazardous health-care wastes (12.1% of the total amount of hazardous health-care waste generated) were disposed of in a dedicated landfill area, but there is no landfill in Manaus sanctioned to receive hazardous waste.
3. 40% of medical institutions, however, replied that they do not pay fee for hazardous health-care waste.
4. Many medical institutions indicated using incineration (52.9% of the total amount of hazardous health-care waste generated); however, it will be necessary to check that this is being done properly by referencing the results of the survey of waste service companies and so on.

d.4 Hazardous Health-care Waste Generation Amount

As shown in the following table, survey results show that the generation amount and unit generation of hazardous health-care waste are comparable to other JICA surveys. The results show that the amount of hazardous waste produced by PIM factories differs from surgical hospitals and the like; a comparison of the unit generation amount (1.95 g/person/day) revealed a much higher amount than expected.

Table 3-41: Hazardous Health-care (Medical) Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	20,000	3.54
Turkey / Adana	1998	1,196,620	4,401	3.68
Turkey / Mersin	1998	643,850	1,539	2.39
Azerbaijan / Baku	2000	2,051,200	12,892	6.28
Cambodia / Phnom Penh	2003	1,199,414	961	0.80
Sri Lanka / Kandy	2002	110,049	530	4.81
Mongol / Ulaanbaatar	2005	866,591	1,600	1.85
PIM in Manaus	2009	116,192([*1])	229	1.97

Source: JICA solid waste management study reports

Note *1: The number of employees at 440 operating factories, as of August 2009

Table 3-42: Common Health-care Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	44,658	7.92
Turkey / Adana	1998	1,196,620	11,805	9.87
Turkey / Mersin	1998	643,850	4,663	7.24
Azerbaijan / Baku	2000	2,051,200	20,588	10.04
Cambodia / Phnom Penh	2003	1,199,414	9,719	8.10
Sri Lanka / Kandy	2002	110,049	4,734	43.02
Mongol / Ulaanbaatar	2005	866,591	14,800	17.08
PIM in Manaus	2009	116,192(*1)	239	2.06

Source: JICA solid waste management study reports

Note *1: The number of employees at 440 operating factories, as of August 2009

3.5 Study of Construction Waste Management

3.5.1 Outline of the Study

a. Study Objective

The study aims to clarify the generation of construction waste, its disposal and management at PIM factories (including those outside of the DI) where construction projects exist.

b. Study Method

A local consultant (OPCA.) was consigned to conduct the study. The local consultant used a questionnaire produced by the Japanese study team and conducted interviews with those in charge of construction at factories.

The study team produced a draft questionnaire, which was discussed with the C/P and then revisions were made as necessary. The questionnaire contained the following items

- Overview of construction work, contract amount for work, type of work, number of workers
- Generation amount of construction waste
- Type of construction waste
- Final disposal aspects
- Recycling aspects
- Others

3.5.2 Construction Waste Categories

a. Construction Waste Categories in CONAMA Resolution 307

The National Environment Council (CONAMA) issued Resolution 307 in the form of guidelines for construction waste management on 5 July 2002. Construction wastes are categorized in CONAMA Resolution 307 as shown in the following table.

Table 3-43: Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton, metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. *(new text given by Resolution n. 348/04)*.

b. Target Wastes

The target wastes are construction wastes generated by works at PIM factories which are designated in CONAMA Resolution 307.

c. Construction Waste Categories used in the Study

The waste categories in CONAMA Resolution 307 identify criterion for whether or not certain construction waste is recyclable. Thus, it would be difficult to get a detailed picture what kinds of waste were being generated if the survey were conducted based on these categories. The study team discussed the matter with the C/P and decided upon 44 materials (see below) into which construction waste could be categorized and used for the survey. In addition, it was determined in which of the 4 classes given in CONAMA Resolution 307 these 44 wastes would be placed.

- Excavated soil, concrete debris, asphalt debris, brick debris, glass tile and ceramic materials, foam polystyrene, vinyl materials, synthetic rubber, used tires, plastic sheet, vinyl sheet, iron-bar, steel materials, small metal waste, old temporary scaffoldings and fences, natural rubber waste, sludge, mud, plaster boards, packaging material which organic materials stick to, lead battery, wood debris of demolish waste, timber form for concreting, scaffolding material, interior timber materials, packing materials (such as cardboard), wall paper, cloth and old rags, rope, carpet, machine oil, heavy oil, asphalt, waterproof sheet, ash of materials used for construction (such as old rags, cardboard, timber), materials containing asbestos, materials which are sprayed with asbestos, transformer, condenser, stabilizer for fluorescent light, sulfuric acid, coolant for a freezer, volatile oil, kerosene, diesel oil, mixed waste.

The 44 construction waste categories and the questions asked are presented in the Section 2.4.6 of the Supporting Report.

3.5.3 Selection of Target Factories

The 457 factories located in the MFZ in the factory list provided by SUFRAMA, were contacted to confirm whether they had conducted any construction projects in the past year, from June 2008 to May 2009. The following results were found according to their responses.

- Factories that responded by telephone: 334
- Factories that have closed: 17
- Factories that refused to reply: 25
- Factories that could not be reached by telephone: 81

In this survey, it was revealed that 440 factories are PIM factories operating in the MFZ, including those which could not be reached by telephone (which was likely due to a changed phone number, etc.) and excluding the 17 which have closed.

It was found that, of the 334 factories, 123 factories, over one-third (36.8%), have conducted construction projects between June 2008 and May 2009. Ten of the 123 factories were chosen at random for direct interview using the prepared survey questionnaire. A summary of these factory construction projects is given below.

Table 3-44: Summary of Construction Projects

Type of Construction Project	No. of Respondents	Ratio (%)
1. New construction	2	20.0
2. Additional construction	0	0.0
3. Demolition	0	0.0
4. Renovation	6	60.0
5. Others*1	2	20.0
Total	10	100.0

Note *1: In detail,
1. Installation of a waste water treatment facility (WWTF)
2. Construction of a retaining wall and drainage of the rain water.

3.5.4 Execution of the Survey

A local consultant (OPCA) was consigned to conduct the study on 19 June 2009. Immediately after the contract was signed, the local consultant contacted all PIM factories approved by SUFRAMA by telephone, etc., and inquired about any construction works that took place over the past year, before selecting the target factories and beginning the direct interview process. The direct interview survey and compiling the survey result were completed as planned by the end of July, and then, working with the study team, the survey results were analyzed in August before being summarized into a report.

3.5.5 Results of the Survey

a. Generation Amount of Construction Waste

In the year from June 2008 to May 2009, the amount of construction waste generated from construction projects at the 10 factories came to a total of 832.7 tons, as shown in column A in the following table. Moreover, the amount generated per day is shown in column B (B = A/365).

Table 3-45: Generation Amount of Construction Waste from Survey of 10 Factories

Waste No	Description of Waste	Total Number of Answer	A. Generation Amount (kg)	B. Generation Amount (kg/day)	Classification & Generation of Waste by CONAMA Resolution 307 (kg/day)			
					Class A	Class B	Class C	Class D
01	Excavated soil	5	32,985	90.4	90.4			
02	Concrete debris	7	53,830	147.5	147.5			
03	Asphalt debris	1	62,500	171.2	171.2			
04	Brick debris	5	3,015	8.3	8.3			
06	Tile and ceramic	1	10	0.0	0.0			
11	Plastic/vinyl sheet	1	430	1.2		1.2		
12	Iron-bar, steel materials	5	250	0.7	0.4	0.3		
13	Small metal waste	5	571	1.6	0.1	1.5		
17	Plaster boards	1	20	0.1	0.1			
20	Wood debris	3	1,335	3.7	2.8	0.8		
21	Timber form	1	200	0.6		0.6		
22	Scaffolding material	1	1,230	3.4		3.4		
23	Interior timber	3	1,150	3.2	2.9	0.3		
24	Packing (cardboard)	4	960	2.6	0.3	2.3		
29	Machine oil	1	74	0.2	0.2			
33	Ash	2	165	0.5	0.5			
44	Mixed construction waste*1	2	674,000	1,846.6	1,846.6			
	Total	48	832,725	2,281.4	2,271.2	10.3	0.0	0.0

Note *1: Large-scale construction projects were confirmed at two factories which took place over the course of 6 months and 1 year produced a large amount of construction waste.

b. Number of Factories in PIM

123 factories of 334 surveyed have a construction works within their compound. It is estimated 162 (= 123x 440/334) factories have a construction works in PIM in total.

c. Generation Rate and Amount of Factories in PIM

As 162 factories have a construction works in PIM in total, the generation amount of construction waste from factories in PIM and generation rate per employee is calculated as follows:

Generation Amount of Factories in PIM
= Generation Rate per a factory with construction works x 162
Generation Rate per an Employee
= Generation Amount of Factories in PIM / Number of Employee in PIM (116,192)

Table 3-46: Generation Rate and Amount of Factories in PIM

Waste No	Description of Waste	Generation Rate per a factory (kg/factory/day)	Portion (%)	Generation Amount of Factories in PIM (C=Bx440/334) (ton/day)	Generation Rate per an Employee (kg/employee/day)
1	Excavated soil	9.04	4.0	1.46	0.013

2	Concrete debris	14.75	6.5	2.39	0.020
3	Asphalt debris	17.12	7.5	2.77	0.024
4	Brick debris	0.83	0.4	0.13	0.001
6	Tile and ceramic	0.003	0.0	0.00	0.000
11	Plastic/vinyl sheet	0.12	0.1	0.02	0.000
12	Iron-bar, steel materials	0.07	0.0	0.01	0.000
13	Small metal waste	0.16	0.1	0.03	0.000
17	Plaster boards	0.01	0.0	0.00	0.000
20	Wood debris	0.37	0.2	0.06	0.001
21	Timber form	0.06	0.0	0.01	0.000
22	Scaffolding material	0.34	0.1	0.06	0.001
23	Interior timber	0.32	0.1	0.05	0.000
24	Packing (cardboard)	0.26	0.1	0.04	0.000
29	Machine oil	0.02	0.0	0.00	0.000
33	Ash	0.05	0.0	0.01	0.000
44	Mixed construction waste	184.66	80.9	29.92	0.258
	Total	228.18	100.0	36.96	0.318

From the above, it was estimated that the daily generation amount of construction waste in the target area (PIM/MFZ) is 37.0 ton/day. The categorization according to CONAMA Resolution 307 for construction waste which is generated is as follows. Note that there was no hazardous construction waste confirmed in this study.

- Class A (reusable or recyclable as aggregate): 36.8 ton/day
- Class B (recyclable as material other than aggregate): 0.2 ton/day
- Class C (not economically feasible for recycling): 0.0 ton/day
- Class D (hazardous): 0.0 ton/day

d. Present Construction Waste Management Stream

The present construction waste management stream in PIM, according to the survey of construction works, is shown in the following figure.

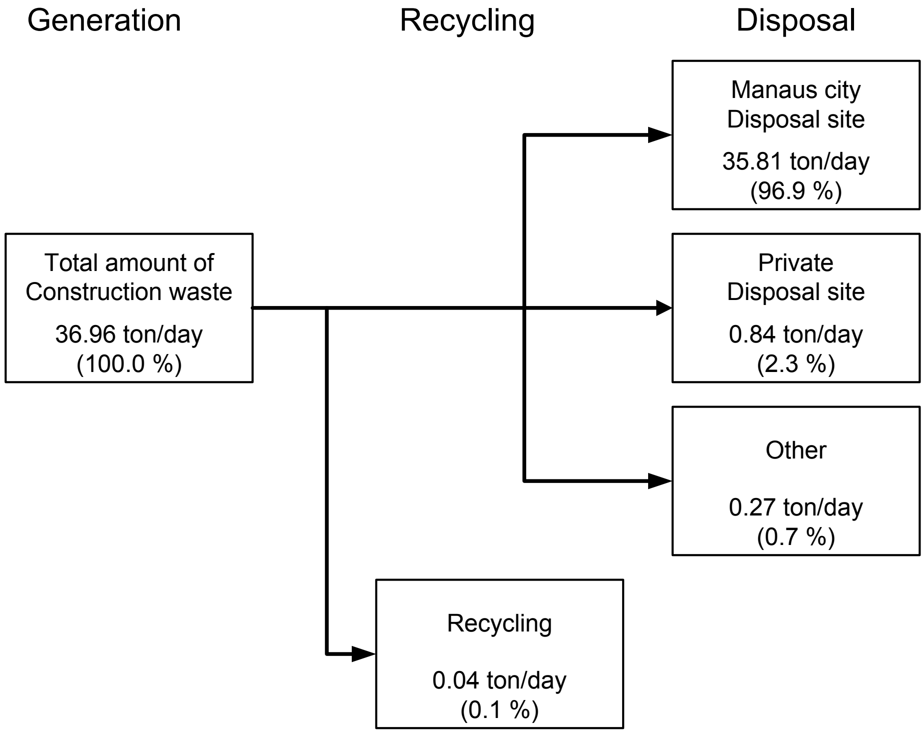


Figure 3-12: Construction Waste Management Stream in PIM

e. On-Site Construction Waste Management

e.1 Environmental License for Construction Projects

Of the total number of factories, about 60% had obtained environmental licensing to undertake a construction project.

e.2 Integrated Management Plan for Construction Waste

Of the total number of factories, about 60% had formulated a construction waste management plan as outlined in CONAMA Resolution 307.

e.3 Recycling

Of the 10 factories surveyed, only one factory replied that it resold the following five items.

- Iron-bar, steel materials
- Small metal waste
- Wood debris
- Interior timber
- Packing (cardboard)

This amounted to a total amount of 900kg, which, when calculated for the generation rate (GR) amounts to 0.247kg/day (GR = 900/365/10). Accordingly, the total recycling amount (TRA) for the entire PIM/MFZ was estimated to be 40 kg/day (TRA = 0.247 x 440 x 123 / 334), which is less than 0.1% of the generation amount.

e.4 Discharge

The responses concerning off-site discharge of construction waste that was generated revealed that 44 of the 48 items surveyed, or 91.7%, was collected by private collection companies that had been contracted for their services. Two items, or 4.2%, were offloaded to the Manaus City collection service.

f. Off-Site Construction Waste Management

f.1 Manifest (Monitoring the Disposal of Construction Waste)

In Brazil, there is no mandate for the use of a manifest for construction waste. It is left to the judgment of each state whether or not use of a manifest is required. In contrast with industrial (manufacturing) waste, Amazonas State does not require the use of a manifest in this instance. As such, respondents indicated that a manifest was used for only 11 of the 48 items which are discharged, or 22.9%.

Table 3-47: Use of Manifest for Discharged Wastes

Waste No	Description of Waste	Total Number of Answer	Answer		
			a. Yes	b. No	c. I don't know.
01	Excavated soil	5	1	4	
02	Concrete debris	7	2	4	1
03	Asphalt debris	1		1	
04	Brick debris	5	2	2	1
06	Tile and ceramic	1			1
11	Plastic/vinyl sheet	1		1	
12	Iron-bar, steel materials	5	2	2	1
13	Small metal waste	5		4	1
17	Plaster boards	1	1		
20	Wood debris	3		2	1
21	Timber form	1	1		
22	Scaffolding material	1		1	
23	Interior timber	3	1	2	
24	Packing (cardboard)	4	1	2	1
29	Machine oil	1		1	
33	Ash	2		2	
44	Mixed construction waste	2		2	
Total		48	11	30	7

f.2 Construction Waste Disposal

According to respondents, 26 of the 48 wastes discharged, 54.2%, are disposed of at the Manaus City landfill, as shown in the table below. This accounts for 54.2% of the items, yet in actuality, in terms of the amount disposed, 96.9 % of construction waste is disposed in the Manaus City landfill.

Table 3-48: Disposal of Construction Wastes

Waste No	Waste materials generated in your site		Total Number of Answer	Answer			
				Manaus City Landfill	Private Landfill	Other	Do not know
01	Excavated soil		5	3	1	1	
02	Concrete debris		7	5	1		1
03	Asphalt debris		1	1			
04	Brick debris		5	3	1		1
06	Tile and ceramic		1				1
11	Plastic/vinyl sheet		1	1			
12	Iron-bar, steel materials		5	2	1	1	1
13	Small metal waste		5	1	1	2	1
17	Plaster boards		1	1			
20	Wood debris		3		1	1	1
21	Timber form		1	1			
22	Scaffolding material		1	1			
23	Interior timber		3	1	1	1	
24	Packing (cardboard)		4	2		1	1
29	Machine oil		1		1		
33	Ash		2	2			
44	Mixed construction waste		2	2			
Total			48	26	8	7	7
Disposal amount by the Survey		(kg/day)	2,281.4	2,211.1	51.0	18.9	0.5
		(%)	100.0	96.9	2.3	0.8	0.0
PIM disposal amount (ton/day)			36.97	35.82	0.85	0.30	0.0

g. Issues on Construction Waste Management

The following issues were identified from the construction waste survey.

g.1 Construction Waste Management System Provisions

Over 1/3 of PIM factories (36.8%) carried out construction projects over the course of one year, from June 2008 to May 2009. The generation amount of the 10 factories surveyed estimated for all of the PIM factories is calculated as 37 tons per day, or an annual amount of 13,500 tons of construction waste generated. Although in this study there is no report of hazardous waste discharge, the hazardous waste asbestos is used in various construction materials. Therefore, based on the results of this survey, it is necessary to provide a management system to grasp a more accurate picture of construction waste, and particularly hazardous waste.

g.2 On-Site Management

Waste management at construction sites for on-site construction waste is judged to be established to a certain level according to the following facts.

- Construction waste is divided into 44 categories, according to respondents.
- Approximately 60% of factories have formulated a construction waste management plan as outlined in CONAMA Resolution 307.

Nevertheless, two factories that discharged a large amount of waste confirmed that it was mixed. Thus, from a quantitative standpoint, the mixed discharge rate is 80%.

g.3 Recycling

Contrary to the designs of CONAMA Resolution 307, the present recycling rate of construction waste is extremely low at 0.1%. Also, over 80% of the quantity is discharged as non-separated waste and disposed of at the Manaus City landfill. The cause for this is that motivation needed to encourage dischargers to separate and recycle to reduce their disposal expenses is lost, (i.e. the Manaus City landfill does not collect a disposal fee).

g.4 Hazardous Construction Waste

Class D hazardous waste, as defined in CONAMA Resolution 307, was not reported in this study. However, renovations account for 60% and asbestos, a hazardous waste material, is used in ceiling and roofing materials as well as water storage tanks and so forth. In addition, construction generally generates waste oil and organic solvents, so it is necessary to confirm whether there are truly no hazardous wastes generated. Furthermore, if they are generated, it will be necessary to confirm the treatment and disposal methods used in a future study.

g.5 Understanding Current Conditions of Off-Site Disposal

After discharge, the final disposal of most construction waste (96.9%) is done at the Manaus City landfill. If this waste does not contain hazardous substances, such final disposal is not a problem, however the actual situation remains unclear. It is necessary to work with the City of Manaus to confirm that appropriate disposal methods are being followed.

3.6 Study of Radioactive Waste Management

3.6.1 Outline of the Study

a. Study Objective

The study aims to clarify the current management practices of radioactive waste management by visiting PIM factories where radioactive materials are used and there is a possibility that wastes will be generated, and conducting interviews to assess the types of radioactive materials used, the management conditions, and whether or not radioactive waste is generated.

b. Study Method

The management of radioactive waste was confirmed with stakeholders that attended the first weekly meeting in the study. There it was revealed that a single entity, the National Commission of Nuclear Energy, Ministry of Science and Technology (CNEN), manages radioactive waste, with the exception of small-scale businesses in the medical sector. Still, it became apparent that the management practices of radioactive materials used by businesses in the target area (MFZ) are unclear.

Thus, members of the study team visited the CNEN headquarters in Rio de Janeiro to conduct an interview. There it was discovered that there are 14 institutions using radioactive materials in Manaus, as shown in the table below.

Table 3-49: Institutions in PIM that use radioactive material

No	Purpose of Use	Reg No.	Institution
1	Large-sized irradiators	14522	Amazonas State Hematology and Hemotherapy Foundation
2	Nuclear medicine (with non-sealed sources)	11649	Amazonas State Nuclear Medicine and Ultrasonography Center
3		14234	Rio Solimões Institutional Support Foundation - UNISOL
4	Nuclear measurers - Process control	13686	Amapoly Industria e Comercio Ltda
5		14606	Brasil Norte Bebidas Ltda
6		14386	Cervejarias Kaiser Brasil S/A - Manaus/Am
7		14569	Cia de Bebidas das Americas - Ambev - Filial Manaus
8		14579	Microservice Tecnologia Digital da Amazônia Ltda
9	Research	12546	Amazon National Research Institute – INPA
10	Prospection of Oil	10571	Schlumberger Servicos de Petroleo Ltda - Urucu
11	Radiotherapy	11457	FCECON - Oncology Control Center Foundation
12		14886	IMAM - Instituto de Mama do Amazonas Ltda
13	Analytical techniques	13760	COIMPA Industrial Ltda
14		14932	Instituto Nokia de Tecnologia

Note *1: Listed in the “Profile of the Companies with Projects Approved by SUFRAMA - Dez/2008”

Eight of the 14 facilities listed above were selected and visited for direct interviews. The study team provided a draft questionnaire form, which was used as the basis for discussion with the C/P, and then revised. The questionnaire contained the following items:

- Existence of usage permit and management standards
- Intended purpose for radioactive materials
- Types and management of radioactive materials
- Whether or not radioactive waste is generated
- Types of radioactive waste and generation amount
- Treatment and disposal methods of radioactive wastes
- Other

3.6.2 Legislation and Administration related to Radioactive Waste

a. Management of Radioactive Materials

Radioactive materials are managed by a single institution: the National Commission of Nuclear Energy, Ministry of Science and Technology (CNEN). CNEN has established the following regulations concerning the management of radioactive materials.

1. Licensing of Radioactive Facilities CNEN-NE-6.02 – September 1984
2. Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05 – December 1985

Licensing regulations divide radioactive facilities into 3 classes and 10 groups, with stipulations for each group to acquire the necessary license.

b. Management of Radioactive Waste

Regulation for the management at radioactive facilities of radioactive waste purports that the waste is categorized as shown below and managed accordingly for each category.

Table 3-50: Categorization of Radioactive Waste

Class	Type	Level
1. Waste containing beta or gamma emitters	1.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	1.3 Gaseous Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
2. Waste containing alpha emitters	2.1 Liquid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste
	2.2 Solid Waste	・Low Level Radioactive Waste ・Mid Level Radioactive Waste ・High Level Radioactive Waste

Source: Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05 – December 1985

3.6.3 Selection of Target Facilities and Execution of the Survey

Of the following 14 institutions using radioactive materials in Manaus, eight were selected and then visited to conduct direct interviews. The study team directly hired an aid to assist in the survey. The interviews and compiling the results was completed as planned by late July, and the study team prepared the report in August 2009.

Table 3-51: Institutions using Radioactive Materials in Manaus

Type	Number of Factories/Institutions
Large-sized Irradiators	1
Nuclear Medicine (with non-sealed sources)	2

Nuclear Measurers - Process Control	5
Research	1
Oil Prospection	1
Radiotherapy	2
Analytical Techniques	2
Total	14

3.6.4 Results of the Survey and Findings

a. Administration on Radioactive Waste Management

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, is solely responsible for the management of radioactive substances through activities such as issuing guidelines for handling radioactive material and radioactive-contaminated material, granting licenses, monitoring, and construction of facilities to handle radioactive materials. CNEN issues regulation of radioactive materials (Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985).

Based on CNEN-NE-6.05, standards for the handling of health-care radioactive waste are established by the National Environment Council (CONAMA) and the National Health Surveillance Agency (ANVISA), respectively, as shown below:

- Treatment and Final Disposal of Health-care Waste: CONAMA Resolution 358/2005
- Appropriate Management Criteria for Health-care Waste: RDC 306/2004-ANVISA

b. Generation Amount of Radioactive

b.1 Selection of Target Factories/Organizations

According to CNEN, they have issued licenses for the use of radioactive materials to 14 factories and organizations in the target study area. During the survey, 8 factories and medical institutions of these 14 were selected for direct interviews.

- Factories located in the Industrial District (DI) which use these materials for manufacturing process control, etc.: Five (5)
- Factories located in DI which use these materials for analytical techniques, etc. of those manufactured goods: Two (2)
- Organizations located outside of DI which use these materials for nuclear medicine diagnosis: One (1)

b.2 Generation Amount of Radioactive Waste

According to survey responses from the 8 factories and organizations on their use of radioactive materials, neither claimed to generate radioactive waste. It is therefore assumed, given that the facilities and equipment are relatively new, that radioactive waste is not generated.

c. Radioactive Materials Management in PIM

As mentioned above, according to the response of the 8 factories and organizations surveyed, there are no radioactive wastes presently generated in the target study area. Based on the response from 7 factories, the current conditions of radioactive materials management at PIM factories is give below.

c.1 Licensing

All seven of the factories have obtained licensing for the use of radioactive materials.

c.2 Intended Use of Radioactive Materials

The intended use of radioactive materials is given in the table below, including process control, quality control and the like.

Intended Use	No. of Respondents	Ratio (%)
Filling level inspection/measurement	4	57.1
Measurement of the PVC sailcloth in the process	1	14.3
Products dimension control	1	14.3
Verification of the solder	1	14.3
Total	7	100.0

c.3 Shield against Radiation Sources

Radiation sources are all shielded, with the exception of one location. At one location radioactive light is used as an irradiation lamp.

c.4 Containment of Radiation Sources

Containment of radiation sources is as follows.

Conditions of Radiation Source Containment	No. of Respondents	Ratio (%)
It is stored inside of the controlled area with special container	2	28.6
It is stored inside of the controlled area and installed inside of the X-ray equipment	3	42.8
It is installed in a level measurement device	1	14.3
It is installed in a device within a controlled area	1	14.3
Total	7	100.0

c.5 Location of radioactive light emitting equipment

All seven factories use radioactive light emitting equipment in controlled localities.

4. Current Industrial Waste Management and Issues

4 Current Industrial Waste Management and Issues

4.1 Administration of Industrial Waste Management

4.1.1 Industrial Waste-related Policies

a. National and Regional Plans

a.1 National Sustainable Development Strategy

Brazil is organized into a federative system of 26 states and 5,507 municipalities, plus the Federal District, where is located the three Powers of the Republic. Social, cultural and economic diversity is great and is reflected in the production and consumption of goods, with the resulting of industrial waste.

The Brazilian Agenda 21 was signed in July 2002 by the president Fernando Henrique Cardoso, in preparation for the World Summit on Sustainable Development. This comprehensive strategy is not classified as an official government document. Rather, it was created through years of extensive consultation across all sectors of society, and is consequently classified as a “social pact”. The extent to which the government is bound by this pact is unclear.

The Brazilian Agenda 21 provides an overview of the development process of this strategy, acknowledging the challenges, lessons learned and actors involved. The Agenda expands upon the concept of sustainable development, and how Brazil’s situation fits into the international context. The bulk of the Agenda outlines several objectives, including actions and recommendations. The objectives are organized under the following five priority areas:

- The economy of savings in the society of knowledge
- Social inclusion for a solidarity society
- Strategy for the urban and rural sustainability
- Strategic natural resources: water, biodiversity and forests
- Governability and ethics for the promotion of sustainability

The final components of the Agenda include a discussion on implementation mechanisms and instruments, accompanied by an overview of accomplishments already undertaken in this country.

Under the Brazilian Constitution, the government’s Multi-Year Plan (Plano Plurianual - PPA) must be prepared every four years and approved by the National Congress. The PPA includes the programs that are to receive funding. In 1999, when the 2000-2003 PPA was prepared, it incorporated information on consultations undertaken and documents written to date which pertained to the basic themes of the Brazilian Agenda 21. It was hoped that by incorporating these themes at the national planning level they would, in turn, eventually be incorporated into public policies.

The 2004-2007 PPA, created under President Lula resulted in a major budget cut for the environmental sector. However, “the great innovation of the new PPA is the insertion of the environmental dimension on the National Development Strategy. The government wants to integrate environmental questions with Brazil's development policy. The other four dimensions of the Plan are: social, economic, regional and democratic".

Although the Brazilian Agenda 21 is not named clearly as a national sustainable development strategy, the Agenda notes that "the common objective to be achieved is not restricted to the preservation of the environment alone, but to a progressive and expanded sustainable development, which brings into discussion the search for balance between economic growth, social equity and environmental preservation". Further the three target dimensions of sustainability are embedded in the objectives addressed in the Agenda, ranging from natural resource management and conservation issues, to social inclusion and income distribution, through to economic mechanisms, governance and international relations.

a.2 Priorities of 2008/2011 PPA (Federal Government)

The 2008-2011 Multi-Year Plan (Plurianual Plan - PPA) contains all the goals and guidelines of the federal government, in addition to the forecast of public expenses for that period. This PPA was sent on August 31 of 2007 by the government of President Lula da Silva, in order to be submitted to the consideration of the National Congress.

The PPA is always elaborated in the first year of the mandate of the elected president. Thus, those years are characterized by an intense mobilization in the social field, since organizations articulate and are mobilized with the intention of intervening in the budget, particularly to extend the resources destined to social policies.

The PPA defines, by regions, the directives, objectives and goals of the federal public administration for capital expenses, derived expenses of these objectives and goals and the expenses of programs of continued duration.

The 2008/2011 PPA is based on three axes: "economic growth", "quality education" and the "social agenda". The contents of these axis correspond, respectively: (i) to the Growth Acceleration Program (PAC), that orients the infrastructure policy of the second mandate of the federal government, with special emphasis in works related to the power and transportation sectors; (ii) to the Plan for the Development of Education (PDE), that has the objective to improve the quality of Brazilian education; and (iii) to the Social Agenda, whose main policy is the continuity of focused programs of "transference of income", such as the program "Family Stipend" (Bolsa Família), and the investments in the area of public security.

a.3 Strategic Plan of Amazonas State Government

The government's strategic plan defines the top-objectives of the State and establish government frameworks, the territorial dimension, challenges and orientation that guide the planning of actions to be developed, and the evaluation of its implementation[1].

It is intended, therefore, from the challenges, guiding every State Secretariat in the definition of the whole program.

The frameworks of the government express a vision of the future and say how the government wants to be known at the end of the Plan period. The frameworks proposed for the PPA are:

- The government will prioritize the socioeconomic development, on a sustainable basis, the use of regional potentials, building the human resources development of citizens.

[1] Source: Project of Law (Volume II), Pluriannual Plan 2008-2011, Government of Amazonas State

- The government will ensure the economic sustainability of the State, the Interior and the Capital.

The government will modernize the public services management for service quality of social demands.

The top-objectives are represented by actions to be developed in following segments:

- Sustainable socioeconomic development;
- Enhancement of human development, with emphasis on education;
- Improvement of public service and operational management of the government Administration.

As regards the territorial dimension, this expresses the need to observe local demands and have policies that guide the actions of the government taking into of differences, needs and opportunities between the various regions of State. The territorial dimension is thus marked by internalization of Development and Ensuring the Sustainability of the Capital (Manaus).

Regarding environmental issues, the Environmental Program of the Amazon 3111 of the PPA 2008-2011, mentions the objective: to reduce environmental impact of potentially polluting activities and/or harmful to the environment in the State of Amazonas, to promote and disseminate education.

The target audience is individuals and companies that develop activities with a potential impact or environmental degradation in the Amazon and the public and private institutions working in the field of environmental education.

However, as the federal PPA, the state PPA focuses on economic development, education and public services, and the insertion of environmental issues is very general, and considerations on industrial waste is almost null.

b. Policies on Environmental Protection and Waste Management

b.1 Agenda 21

Agenda 21 was one the main results of the Eco-92 or Rio-92. The principles of Agenda 21 are consolidated into specific agendas, such as green (forest, biodiversity and genetic resources), the blue (water resources) and brown (urban ecosystem).

Brasil, as a signatory of agreements signed at Rio-92, undertook to develop its own Agenda 21.

In 2007, the Brazilian Agenda 21 was transformed into Agenda 21 program that aims to implement the Brazilian Agenda 21, to develop and implement Local Agenda 21 and to provide continuing education in Agenda 21.

The Brown Agenda, drawn up in Johannesburg, South Africa in 2003, among the subjects is also the management of waste.

The address issues of environmental quality also present in the Brown Agenda in 2006, the Brazilian government issued Decree 5718/March 2006 (later repealed by Decree 6099/2007), in which IBAMA reform its structure and establishing a Department of Environmental Quality (DIQUA) to implement policies for preventing environmental emergency situation or minimizing their impacts.

b.2 CONAMA national proposal on SWM

A Draft Bill was built on a proposal approved by CONAMA in July 1999 and discussed in the National Seminar for National Policy on Solid Waste, sponsored by the Council in 2004. The suggestions made in the event were systematized and consolidated by the Working Group of the Department of Urban and Regional Environmental Management of the Secretariat of Environmental Quality of MMA[1].

The proposal of the National Policy on Solid Waste, and preventive measures regarding waste generation, seeking to encourage reuse, recycling and use of alternative materials to the environment. The proposal is based on the participation of society in planning, formulation and implementation of public policies on regulation, monitoring, evaluation and provision of services. The text will also serve to protect public health and environmental quality, and preserve and ensure the sustainable use of natural resources.

b.3 National Solid Waste Policy

b.3.1. Outline of NSWP

On March 2010, the federal government presented the Substitute of Draft Bill No. 203 (Substitutivo Projeto de Lei No. 203) and its Annexes, which establishes the national solid waste policy and other measures.

After 19 years of discussion, the National Solid Waste Policy (NSWP) was approved by the House of Commons (Camara de Deputados) Representatives on 10 March 2010 and covers all the principles, objectives, tools, guidelines, goals and actions adopted by the federal government, either alone or in cooperation with States, Federal District, Municipalities and private, with a view to integrated and environmentally sound management of solid waste.

It sets 15 goals; among them: the protection of public health and environmental quality, implementation of the 3Rs; adoption of sustainability standards and encouraging the recycling industry, adoption, development and improvement of clean technologies, and integrated waste management.

b.3.2. SWM Plans

Article 14 of NSWP presents the following solid waste plans:

1) The National Plan for Solid Waste,
2) Solid waste plan of the State,
3) Plans for integrated municipal solid waste,
4) Micro-regional plans for solid waste and solid waste plans for metropolitan areas or urban areas,
5) Inter-municipal integrated management of solid waste plans.

Next, main issues (1), (2) and (3) of the National Solid Waste Plan are described.

(1) The National Plan of Solid Waste:

The Article 14, Section 2 of NSWP describes items of the National Plan for Solid Waste, under the coordination of the MMA. The most important items are the following:

- Diagnosis of the current situation of solid waste;

[1] http://www.medioambienteonline.com/site/root/resources/industry_news/2936.html?changer-id=aDw68EEy_km-&&lang=es

- Goals for reducing, reusing and recycling, among others, in order to reduce the amount of waste and waste sent for environmentally appropriate disposal;
- Goals for the energy use of gas generated in units of final disposal of solid waste;
- Targets for recovery and disposal of garbage, the inclusion of social and economic emancipation of recyclable materials are reusable and recyclable;
- Measures to encourage and facilitate the regionalized management of solid waste;
- Guidelines for planning and other activities of solid waste management regional integrated development imposed by a complementary as well as areas of special interest tourism;
- Standards and guidelines for the disposal of waste and, where applicable, of waste;
- Means to be used for the control and monitoring at the national level, the implementation and operation, ensured social control.

(2) Solid Waste Plan of the State

According to Article 14, Section 3 of NSWP, some items are defined as minimum content, the most important of which are the following:

- Diagnosis, including identification of key waste streams in the state and their socioeconomic and environmental impacts;
- Goals for reduction, reuse, recycling, among others, in order to reduce amount of waste and waste sent for disposal environmentally appropriate;
- Goals for the energy use of gas generated in units of final disposal of solid waste;
- Targets for recovery and disposal of garbage, the inclusion of social and economic emancipation of recyclable materials are reusable and recyclable;
- Measures to encourage and enable the consortium or shared management of solid waste;
- Guidelines for planning and other activities of solid waste management in metropolitan areas, urban and micro;
- Standards and guidelines for the disposal of waste and, where applicable, waste, compliance with the provisions laid down nationally.

(3) Plan for Integrated Municipal Solid Waste

The plan for integrated municipal solid waste has items defined as minimum content according to Article 14, Section 4 of NSWP. The most important items are the following:

- Diagnosis of the situation of solid waste generated in their territory containing the origin, volume, waste characterization and disposal and ways of disposal adopted;
- Identify favorable areas for environmentally sound disposal of waste,
- Identification of solid waste generators subject to specific management plan or system of reverse logistics.
- Definition of responsibilities for implementation and operation, including the steps of the plan for solid waste management.
- Programs and environmental education activities that promote non-generation, reduction, reuse and recycling of solid waste;

- Targets for reduction, reuse, waste collection and recycling, among others, in order to reduce the amount of waste sent for environmentally sound disposal;
- Means to be used for the control and supervision, at the local level, implementation and deployment plans for solid waste management systems and logistics for specific (in Art. 33 of Substitute of Draft Bill No. 203).
- Preventive and corrective actions to be taken, including monitoring program;
- Identification of environmental liabilities related to solid waste, including contaminated areas and their remedial measures;

b.3.3. Other Important Issues

(1) Responsibilities

Establishing the shared responsibility for the lifecycle of the product, manufacturers, importers, distributors and marketers will have to invest to market recyclable items that generate the least amount of solid waste. Sets the packaging shall be manufactured from materials that are conducive to reuse or recycling. Measures should be implemented to receive packages and products after use by the consumer (Reverse Logistics) for: pesticides, waste and packaging, batteries, tires, lubricating oils, waste and packaging, fluorescent lamps, and electronic products and components.

In the municipalities that establish waste collection customers are required to be packaged properly and separately with the waste generated and to provide adequate solid waste to reusable and recyclable collection and return to the Government should establish a separate collection, composting system set up (waste processing solid organic fertilizer) and to final destination environmentally sound waste from street cleaning (street sweeping).

The urban sanitation companies should give priority to the work of collection cooperatives formed by low-income people, according to standards of a future regulation.

Municipalities that deploy the collection with the participation of associations and cooperatives of pickers will have priority access to resources in the credit lines under the National Plan for Solid Waste.

(2) Hazardous Waste

Sets the facility or enterprise that manages or operates with hazardous waste may be authorized or licensed to prove their charge capacity and conditions to provide the care needed to manage such waste. However, does not define what characterizes the person as capable and able to provide care. Further stipulates that legal entities that operate with hazardous waste are required to register the National Registry of Operators of Hazardous Waste. The environmental licensing of projects or activities that operate with hazardous wastes, the licensing body of SISNAMA may require placement of insurance against liability for damage caused to the environment or public health.

(3) Prohibitions

The following are prohibited forms of appropriation or disposal of solid waste:

- Released on beaches, at sea or any water bodies;
- Outdoor littering, except for mineral waste;
- Burning practices or open container, plant or equipment not licensed for this purpose;
- Other forms vetoed by the Government.

The provision of waste disposal, including the installation of sanitary landfills and industrial areas, in conservation areas and in areas of environmental conservation or permanent protection of water sources are prohibited in final disposal sites, scavenging activities, animal husbandry, settlements of temporary and permanent residents and others vetoed by the Government.

It prohibited the importation of waste and solid waste characteristics damaging to the environment and public health, animal and plant, even for treatment, renovation, reuse or recovery.

The rule on the final disposal of waste should be implemented within four years after the publication of the law, but state and local plans may set different deadlines, in order to tailor them to local conditions and needs.

c. IWM - related National and Regional Plans

With regard to IWM, CONAMA Resolution No.313/02 establishes the following:

Article 7. In three years from 2002, it shall prepare the State Programs for Industrial Management, and in four years, the National Plan for Industrial Waste Management.

Article 8. Industries, after sixty days from the date of publication of this resolution (21/11/02), must register monthly and keep in the industrial unit the generation and disposal data of waste generated in order to obtain data for the national inventory of industrial waste.

Article 9. Noncompliance with the provisions of this resolution shall be subject to penalties and sanctions for offenders under Law No. 9605 of 12 February 1998 and Decree No. 3179 of 21 September 1999.

CONAMA Resolution Nº 313, of October 29, 2002, discusses the National Inventory of Solid Industrial Wastes.

Considering the absence of precise information concerning the quantity, types and destinations of the solid wastes generated in the industrial park of the country;

Art. 1. The waste existent or generated by industrial activities will be the object of specific control, as an integrated part of the environmental licensing process.

Art. 3. The electric energy concessionaires and businesses that possess materials and equipment containing PCBs will have to present to the state agency of the environment the inventory of these stocks, in the form and place to be defined by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA).

Art. 4. The industries of the types anticipated in the National Classification of Economic Activities of “IBGE”, will have to, within the maximum period of one year after the publication of this Resolution, or in accordance with the period established by the state environmental agency, present to it, information concerning generation, characteristics, storage, transport and destination of its solid wastes.

4.1.2 Factory Classification and IW Classification

a. Factory Classification and Factory List

a.1 SUFRAMA’s Classification of Factories

SUFRAMA classifies factories as shown below into 19 main categories, which, together with sub-categories, total 28 types by sector. In this study, SUFRAMA's 19 main categories were used to summarize the current conditions and issues dealing with industrial waste management in PIM/MFZ.

Table 4-1: SUFRAMA's Factory Classification

Factory Code	Sector		
	Main Category		Sub-category
F01	Beverages		
F02	Leather		
F03	Printing		
F04	Electrical		
		4-1	Parts
		4-2	Products (except copy machines)
		4-3	Copy machines
F05	Lumber		
F06	Machinery		
		6-1	Clock/watch
		6-2	Other machinery industry
F07	Metal		
F08	Nonferrous		
F09	Furniture		
F10	Paper		
F11	Rubber		
F12	Food		
F13	Chemical		
F14	Plastic		
F15	Textiles		
F16	Clothing		
F17	Transportation		
		17-1	Two-wheelers
		17-2	Ships
		17-3	Other transportation
F18	Construction		
F19	Other		
		19-1	Optics
		19-2	Toys
		19-3	Small instruments
		19-4	Writing utensils, razor blades
		19-5	Other

Source: CGPRI & CGMER/COCAD SUFRAMA, up to 8/2008 "Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA "

a.2 SUFRAMA's Factory List

SUFRAMA has created a list of PIM factories (hereafter, SUFRAMA factory list)[1]. The PIM factories on this list are divided into 4 categories.

1. Part 1: Complete Projects (Large Factories) Approved and Installed in PIM
2. Part 2: Simplified Projects (Small Factories) Approved and Installed in PIM
3. Part 3: Complete Projects (Large Factories) Approved and Under Installation in PIM
4. Part 4: Simplified Projects (Small Factories) Approved and Under Installation in PIM

There are a total of 475 factories on the SUFRAMA factory list under Part 1 and Part 2 for large and small factories currently in operation in PIM.

Table 4-2: Factories in Operation on the SUFRAMA Factory List

Factory Code	Inside the DI			Outside the DI			Outside the MFZ			Total number of factory (A)
	Part 1	Part 2	Sub-total	Part 1	Part 2	Sub-Total	Part 1	Part 2	Sub-Total	
F01	4		4	12		12	2	1	3	19
F02										
F03	6		6	3	7	10	1		1	17
F04	73	1	74	52	5	57				131
F05	2	1	3	1		1	2	8	10	14
F06	19		19	9		9				28
F07	23	2	25	20	3	23		1	1	49
F08		1	1	2	3	5				6
F09	1		1	3	1	4		2	2	7
F10	7		7	6		6				13
F11	2		2	1		1				3
F12				5	9	14	1		1	15
F13	13	2	15	15	4	19				34
F14	32	2	34	35	7	42				76
F15				1		1				1
F16				2		2				2
F17	15		15	16	2	18				33
F18		1	1	3	3	6				7
F19	7		7	5	8	13				20
Total	204	10	214	191	52	243	6	12	18	475

a.3 List of PIM/MFZ Factories in Operation

A list of PIM/MFZ factories in operation was compiled, based on the previously mentioned SUFRAMA factory list, according to the following:

- Excluding PIM outside the study target area, MFZ.
- Excluding factories that have been closed, of the 334 factories contacted by telephone

[1] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

during the Medical Institution and construction waste survey.

The current conditions and issues of PIM/MFZ industrial waste management were summarized based on the above results of 440 factories, as shown in the following table.

Table 4-3: List of PIM/MFZ Factories in Operation

Factory Code	Inside the DIs			Outside the DIs			Total No. of Factories (A)
	No of Part 1 Factories	No of Part 2 Factories	Subtotal	No of Part 1 Factories	No of Part 2 Factories	Subtotal	
F01	3		3	12		12	15
F02							
F03	6		6	3	7	10	16
F04	64	1	65	51	5	56	121
F05	2		2				2
F06	19		19	9		9	28
F07	23	2	25	19	3	22	47
F08		1	1	2	3	5	6
F09	1		1	3	1	4	5
F10	7		7	6		6	13
F11	2		2	1		1	3
F12				4	9	13	13
F13	13	2	15	15	4	19	34
F14	31	2	33	35	7	42	75
F15				1		1	1
F16				2		2	2
F17	15		15	16	2	18	33
F18		1	1	2	3	5	6
F19	7		7	5	8	13	20
Total	193	9	202	186	52	238	440

a.4 Factory Registry Database

SUFRAMA releases a monthly report of industrial statistics termed “Performance Indicators of Manaus Industrial Pole”. Factories use an “online performance index system” introduced in 2004 to report these statistical results to SUFRAMA (COISE/CGPRO/SAP) based on actual performance. The results reported by these companies are entrusted to FUCAPI by SUFRAMA and managed in a database.

Meanwhile, SUFRAMA’s CGPRI department issues a “Profile of Companies with Projects Approved by SUFRAMA” (hereafter, the SUFRAMA factory list) on a quarterly basis, which encapsulates the registered factories receiving tax benefits. This factory profile is made in MS Word format, not in database format, but the basic data is taken from the database made by COISE/CGPRO/SAP.

The study team used the SUFRAMA factory list[1] of December 2008 as the basis for the study, but contacted all of the Part 1 & 2 factories on the list (which are supposed to be operating.) to conduct interviews for health-care waste and construction waste. However, it seemed that the SUFRAMA factory list had not been updated because it was found that 17 factories that were no longer operating.

The profile in the factory list is divided into 4 parts, as shown below, which are already categorized into 19 industrial sectors (28, including sub-classes).

Part 1: Complete Projects Approved and Installed in PIM

Part 2: Simplified Projects Approved and Installed in PIM

Part 3: Complete Projects Approved and Under Installation in PIM

Part 4: Simplified Projects Approved and Under Installation in PIM

The categories in the SUFRAMA factory list for registered factories has some variation, but the more detailed list of 18 items from Part 1 are given here. These correspond to a portion of the items contained in the database managed by FUCAPI.

Table 4-4: Items included on the SUFRAMA Factory List (from Part 1)

SUFRAMA Factory List Items			
1	Registration of the National Company Records	10	Long Distance Call / Fax
2	SUFRAMA Registration Number	11	E-mail
3	Situation of Factory	12	Director
4	Company	13	Production Start-up
5	City	14	Facilities area
6	Address	15	Land area
7	Zip code	16	Number of Employee
8	Telephone	17	Share capital
9	Telex	18	Description According to the Standard Code (Name of Products)

b. Industrial Waste Categories

b.1 Classification of Waste in ABNT NBR 10004

Brazilian federal law does not specify the definitions for “waste” or “hazardous waste”, but for the purpose of listing hazardous wastes in a manifest, uses waste categorization from the Brazilian Association for Technical Specifications ABNT NBR 10004 as a reference for those categorized in CONAMA Resolution 6/88 for the categorization of wastes. Although ABNT NBR 10004 and other ABNT specifications have no legal binding authority, ABNT NBR 10004 is used as a reference for a large number of federal and state laws giving it substantial requisite standing. The latest version of NBR 10.004 was established 30

[1] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

November 2004 to replace the 1987 version. This new standard is based on the American hazardous waste standard CFR－Title 40－Environmental Conservation－Part 260-265－Transfer of Hazardous Wastes.

ABNT NBR 10004 classifies wastes in the following categories.

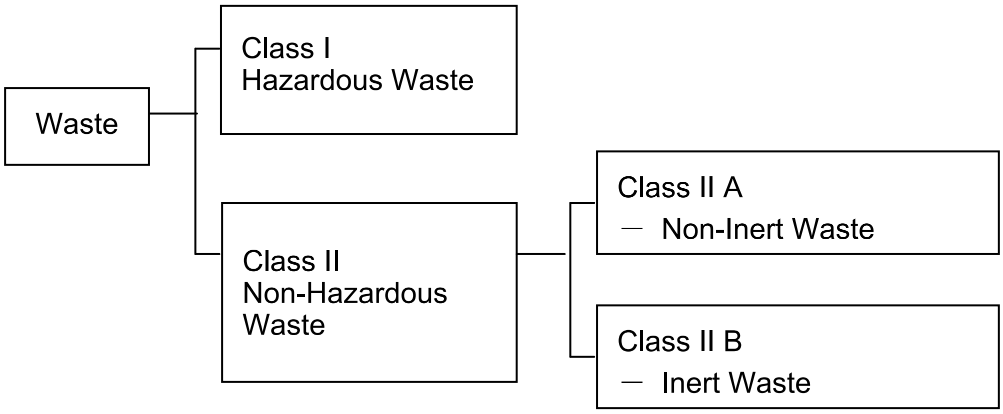


Figure 4-1: Classification of Waste in ABNT NBR 10004

Class I (Hazardous) wastes fall either under the accessory specifications A and B in ABNT NBR 10004 or that for standard hazardous characteristics (ignitable, corrosive, reactive, toxic, pathogenic, etc.). ABNT NBR 10004 Annex A indicates wastes from non-specified sources, whereas Annex B indicates those from specified sources. The material consistency used the standard set out in the 1987 version of ABNT NBR 10004, making it necessary to analyze all wastes, and since this became a great financial burden to dischargers of waste, a change was made in the 2004 version to indicate the generation source.

b.2 CONAMA Resolution 313

CONAMA (the National Council for Environment) issued CONAMA Resolution 313 on October 29, 2002, obligating specific manufacturing industries (factories) to report (i.e. via an industrial solid waste inventory) all waste generated from their activities. Furthermore, using this inventory, CONAMA Resolution 313 sought to have each state environmental agency submit data garnered from the inventory in a set format to IBAMA and formulate a state-level industrial waste management plan.

In the State of Amazonas, all factories are required to create and submit an inventory of the wastes they generated, in accordance with CONAMA Resolution 313.

b.3 Industrial Waste Classification used in this Study

CONAMA Resolution 313 specifies the creation of a waste inventory according to ABNT NBR 10004. ABNT NBR 10004 classifies waste into 3 major groups, as shown in Figure 4-1: Classification of Waste in ABNT NBR 10004.

- Class I: Hazardous Waste
- Class II-A: Non-Hazardous Waste and Non-Inert Waste
- Class II-B: Non-Hazardous Waste and Inert Waste

Although the above classification was used as the basis for this study, the following 4 groups were used for the survey of waste generation sources, composition and management method of waste generated from factories.

1. General Industrial Waste
2. Health-care Waste
3. Construction Waste
4. Radioactive Waste

Although CONAMA Resolution 313 simplified the waste categorization of ABNT NBR 10004 to make it easier for factories to make the waste inventories, it is still difficult for them to identify to which category the waste generated is attributed. Thus, upon discussion with the counterpart, this study used the categorization for the above 4 wastes as shown in the Tables for Classification of Factory and Industrial Waste on the first page of text.

4.1.3 Administration of Industrial Waste Management

a. IWM-related Laws and Regulations

a.1 Federal Level

a.1.1. CONAMA Resolution

There is no basic waste disposal law in Brazil as there is in Japan. At present, the Brazilian Ministry of Environment (MMA) has submitted a comprehensive law dealing with solid waste management (National Solid Waste Policy Bill) PL203/91, which is now under deliberation in the legislature.

However, CONAMA formulates various resolutions dealing with the regulation of industrial waste management. Thus, industrial waste management is basically carried out according to the various resolutions put forth by CONAMA. The following resolutions are those which are primarily related to this study.

- **Resolution CONAMA no. 237/1997** that seeks for the need of revision of the procedures and criteria used in **environmental licensing**, in order to execute the use of the licensing system as an instrument of environmental management, instituted by the Environmental National Policies;
- **Resolution CONAMA no. 307/2002** that establishes guidelines, criteria and procedures for the **administration of construction wastes**;
- **Resolution CONAMA no. 313, of October 29, 2002**, on the **national inventory of industrial solid wastes**; and
- **Resolution CONAMA no. 358, of April 29, 2005**, on **treatment and final disposal of health-care waste and other measures**.

a.1.2. Others

The National Health Surveillance Agency (ANVISA), an independent agency under the Ministry of Health, has established an appropriate management standard, called **RDC 306/2004-ANVISA**, for the medical institutions which are the source of these wastes.

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, issues regulation of radioactive materials (**Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985**).

a.2 State Level

In the extent of state legislation, Law n. 2.712, from December 28, 2001, establishes the Water Sources State Policy and the Water Sources System and the State System of Resources Management.

a.3 Municipal Level

The Municipality of Manaus presents legislation on solid wastes. In general, the legislation acts to forecast urban cleaning public services, postures and the precautions where appropriate in order not to jeopardize the water resources and the environment.

The main legal instrument is the Organizational Law, promulgated on April 05, 1990 which, in Article 80, paragraph f, establishes that the Municipality is in charge of public cleansing, collection, treatment and disposal of waste. Clause VI of Article 229, establishes the items which are mandatory to be taken into account: definition and maintenance of public cleansing systems, including the collection, treatment and final disposal aspects of the waste.

The Municipal Master Plan of November 04, 2002 Law no. 671, regulated the Urban and Environmental Master Plan, establishing guidelines for the development of the city of Manaus. The issue of solid waste is described in Article 7, Paragraphs f) and g); articles 52, 53 and 126.

b. IWM-related Organizations

b.1 General Industrial Waste

Industrial waste management in the State of Amazonas is the jurisdiction of the Institute of Environmental Protection of the State of Amazon (IPAAM); IPAAM does this based on an environmental licensing system.

Waste management in the city of Manaus is the jurisdiction of Municipal Secretariat of Urban Cleaning and Public Services (SEMULSP). This organization owns and operates its own final disposal site, which in addition to municipal solid waste (MSW), also accepts industrial (manufacturing) waste, health-care waste, and construction waste.

b.2 Health-care Waste

In Brazil, a National System of Sanitary Surveillance (SNVS) has been established. According to this SNVS, administration on health-care waste at the federal, state and municipal levels is as follows.

b.2.1. Federal Level

Health-care waste management at the federal level is controlled by the National Health Surveillance Agency (ANVISA), an independent agency under the Ministry of Health. ANVISA has established an appropriate management standard, called RDC 306/2004-ANVISA, for the medical institutions which are the source of these wastes. Appropriate management of health-care waste under the RDC 306/2004-ANVISA standard means that each medical institution which produces waste is required to formulate a health-care waste management plan.

Also, the National Environment Council (CONAMA) has issued regulation for handling health-care waste according to Resolution 358/2005.

b.2.2. State Level

DEVISA/AM (Sanitation Surveillance Department of Amazonas State) is a state-level department under SUSAM, the Health Secretariats of Amazonas State; the structure corresponds to ANVISA under the federal Health Ministry. DEVISA/AM works with the Amazonas State Environmental Protection Institute, IPAAM, to license medical institutions and waste management companies to carry out appropriate management and monitoring of health-care waste at the state level.

b.2.3. Municipal Level

At the municipal level, the Municipal Secretariat of Health (SEMSA) works in a similar capacity as the Ministry of Health at the federal level. Furthermore, Sanitation Surveillance Coordination, a unit in the Municipal Secretariat of the Environment (SEMMA), is the responsible municipal unit for the management and monitoring of health-care waste.

b.3 Construction Waste

In Brazil, administration on construction waste management is as follows:

- Those undertaking construction projects must obtain a construction permit from the city where the construction is to take place.
- Also, depending on the size and substance of a construction project, in the case of any environmental impact, an environmental license must be obtained accordingly.
- Municipalities must formulate a Construction Waste Management Municipal Program, according to CONAMA Resolution 307, and issue guidelines for construction waste management and management standards.
- Those undertaking construction projects must formulate a Construction Waste Management Project, according to the Construction Waste Management Municipal Program, and submit it to the municipality.

b.4 Radioactive Waste

The National Commission of Nuclear Energy (CNEN), under direct control of the Ministry of Science and Technology, is solely responsible for the management of radioactive substances through activities such as issuing guidelines for handling radioactive material and radioactive-contaminated material, granting licenses, monitoring, and construction of facilities to handle radioactive materials. CNEN issues regulation of radioactive materials (Management of Radioactive Wastes in Radioactive Facilities CNEN-NE-6.05—December 1985).

Based on CNEN-NE-6.05, standards for the handling of health-care radioactive waste are established by the National Environment Council (CONAMA) and the National Health Surveillance Agency (ANVISA), respectively, as shown below:

- Treatment and Final Disposal of Health-care Waste: CONAMA Resolution 358/2005
- Appropriate Management Criteria for Health-care Waste: RDC 306/2004-ANVISA

c. Waste Manifest System

Regardless of the fact that Brazil has no systematic standard at the national level, most states have introduced a Waste Manifest System (WMS).

In 2009, the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA) proposed the Terms of Reference for the Elaboration of Wastes Manifest wherein the waste manifest system was regulated as follows, along with proposed provision requirements.

> "WASTES MANIFEST SYSTEM – wastes control system which, using its own form, the so called WASTES MANIFEST, allows one to know and control the destination given by the generator, transporter and receptor of the wastes."

In general, a waste manifest is usually required for industrial (manufacturing) and health-care waste, but not for municipal waste. Recently, obligation for construction waste has also appeared.

The State of Amazonas requires an operational license to be issued to create and submit the forms needed for a waste manifest. Regardless of this, the Institute of Amazonas Environmental Protection (IPAAM), which issues operational licenses, has not established a waste manifest system. In other words, there has been no official recommendation of forms which should be used for the waste manifest. Therefore, dischargers, transporters and those who receive the waste each use their own waste manifest forms.

4.1.4 Administration of Waste Service Companies

a. Registration System

a.1 Registration System for Waste Service Companies in the State of Amazonas

Registration of waste service companies is handled by the Institute of Amazonas Environmental Protection (IPAAM). However, IPAAM does not register the companies themselves, but instead registers the environmental license of the waste service companies. The primary activity of IPAAM for environmental administration is to issue and manage environmental licenses, monitoring, and inspection; in this way, waste service companies are managed through the approval and issuance of environmental licenses.

a.2 Environmental Licensing

In the State of Amazonas, an environmental license must be obtained for any activity (industry) that could potentially impact the environment (Derecto No 10028 de 04 de Febreiro de 1987). These licenses are required not only for the installation and operation of factories, but for most activities where environmental impact is likely, including construction projects, agricultural, medical and so on.

There are three types of environmental licenses, as shown below. Business activities require three types of license be obtained.

- Previous License (PL): Granted at the preliminary stage of the enterprise or activity. It is granted for up to one year, after which the license must be reissued. In order to obtain the PL license, the place and activity must be approved in accordance with local government guidelines.
- Installation License (IL): Authorizes the construction of a factory and installation of a facility, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.
- Operation License (OL): Authorizes the operation of the activity or enterprise, with a maximum term of 2 years; it is necessary to extend the license prior to expiration.

a.3 IPAAM List of Waste Service Companies (WSCs)

IPAAM environmental licensing covers all industries that impact the environment using a 4-digit code (01**). The first two digits designate the major division of industries into 32 classes, and the last two digits further divide these into sub-classes. The study team used this classification system to compile a list of waste related activities, as shown in the table below.

Table 4-5: Waste Service related Codes of IPAAM for Environmental Licensing

Code	Class	Code	Sub-Class	
				Impact
22＊＊	Commerce and Services	2217	Incineration	High
		2218	Co-processing of wastes	High
		2219	Agrochemical Collection Center	Moderate
24＊＊	Other Services (including provision of electricity and water)	2407	Solid Industrial Waste Collection and/or Treatment	High
		2408	Municipal Waste Final Destination	High
		2410	Collection and Transport of Inert Solid Waste	Minimal
		2411	Collection and/or Storage and/or Commercialization of Solid Waste (e.g. recycling)	Moderate
		2412	Collection and/or Treatment of Hazardous Liquid Industrial Waste	High
		2417	Industrial Waste Disposal in Landfill	High
26＊＊	Transportation	2615	Transport and Storage of Hazardous Solid Industrial Waste	High
30＊＊	Waste Treatment and Recycling	3001	Treatment and Recycling of Solid Industrial Waste without chemicals	Moderate
		3002	Treatment and Recycling of Industrial Liquid Waste	Moderate
		3003	Treatment and Recycling of Solid Industrial Waste without Chemicals	High
		3004	Treatment and Recycling of Palettes	Moderate
		3005	Paper and Cardboard Recycling	Moderate
		3006	Treatment and Recycling of Mineral Waste (Waste Re-processing)	Moderate

Source: Classificacao das Fontes Poliudoras IN 001;06 Publicada em (3/12/2007)

b. Current Administration Conditions

In the same way that other industrial activities that must obtain environmental licenses, IPAAM manages waste service companies through the renewal of maximum 2-year Operational Licenses. Although the IPAAM environmental licenses have been digitized, the following issues were identified:

The database server is old and does not function sufficiently. Furthermore, the database system is used for file management (to track where certain files are located), and thus is not set up for license management.

Other information about IPAAM activities is mixed with the environmental license data and managed in the same database, making it extremely difficult to extract the license information needed.

As shown in Table 4-5: Waste Service related Codes of IPAAM for Environmental Licensing, waste service companies are registered by codes for various related activities.

It became evident that not all of the waste service companies were shown in the IPAAM WSC List because it only lists those companies which have a code for waste service related activities. Also, once a list was compiled of the companies that are no longer in business or ceased their waste service related activities, it was not possible to identify them in the IPAAM WSC List, suggesting that licenses are not properly renewed and pointing to the need for a series of improvements to be made.

IPAAM indicated that improvements will be made to their registration system for waste service companies so it will be more effective. Furthermore, those companies without environmental licenses will be encouraged to register, and the system reinforced by updating the database of IPAAM waste service companies—which will be constructed during this study.

c. Current Condition of Waste Service Companies

Present conditions are similar to those mentioned above in that it is not possible to clarify the number of waste service companies in the study area or in what activities they are engaged. Moreover, it is reasonable to say that there are a number of parties engaged in waste services without having obtained the appropriate environmental license. In the very least, this study was able to recognize 23 companies after carrying out a survey of waste service companies.

The following table shows the business sector of companies that have environmental licenses based on an examination by the study team with support from the local consultant of the licenses of 67 waste service companies.

Table 4-6: Categorization of Waste Services of 67 Companies with Environmental Licenses

Possession of Environmental License	Collection / Transportation	Intermediate Treatment	Final Disposal	Reuse / Recycling	Unable to categorize *1	Total
With EL	26	24	0	21	4	75

Note *1: An actual visual check of the licenses was unable to confirm the corresponding work conducted by the WSCs; the content of the licenses were as follows: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide, 3. Retailer of wood products

4.2 Present Generation of Industrial Waste

4.2.1 Previous Studies

A number of PIM factories have been submitting a waste inventory (WI) to SUFRAMA since 2002. SUFRAMA subsequently has compiled the WI from 2005 to 2008 as shown in the following table.

Table 4-7: Inquiries and Answers for Waste Inventory

Item	2005	2006	2007	2008
Questionnaires Sent	186	223	229	229
No. of Respondents	102	94	126	110
Ratio of Response (%)	54.8	42.2	55.0	48.0
Did not answer	84	129	103	129

Table 4-8: Generation Rate from Responding Factories

Unit: ton/year

Waste Type	2005	2006	2007	2008
Factories that responded	102	94	126	110
1. Non Industrial Waste	4,286.6	5,950.4	6,581.0	5,268.3
2. Various	37,565.6	35,226.4	38,250.9	41,058.4
3. Rubber and sludge	1,847.2	8,742.4	4,292.0	4,852.2
4. Contaminated waste	338.0	291.3	17,195.0	2,935.7
5. Dangerous residues	6,858.5	2,583.5	2,093.8	2,112.9
6. Metallic waste	9,432.7	43,769.1	33,913.3	30,351.8
7. Liquid waste	1,549.0	6,856.5	662.1	5,658.7
Total	61,877.7	103,419.5	102,988.0	92,238.0

The above attempt to analyze the WI received, shown above, did not clarify the overall generation of waste in PIM in terms of characteristics and quantity, nor the actual conditions of management of those wastes.

Based on the table above, the study team estimated the IW generation amount from all PIM as follows:

- The number of factories that submitted the WI in 2008 is 110 and total number of employees of the 110 factories 40,007.
- The IW generation rate per employee, per day is calculated as follows:

$$Generation\ unit\ (kg / employee / day) = \frac{92{,}238.0}{(40{,}007 \times 365)} \times 1{,}000 = 6.3$$

- Total IW generation amount is calculated at 732.0 ton/day by multiplying the generation rate with number of employees (116,192) of PIM.

Total IW generation amount of 732.0 ton/day seems to be quite similar to the study team's estimate 628.9 ton/day if we consider the inclusion of wastewater treatment amount, etc.

4.2.2 Current IW Generation Amount

a. Estimation Method

a.1 Generation Rate Method

The current amount of industrial waste being generated was estimated using a generation rate method. This method requires the following indicators.

- Generation rates of factories by sector and type of waste.
- Activity indicators such as number of employees, shipment values, etc. In this study, the former was given that factories would be more forthcoming with their number of employees rather than shipment values.

a.2 Estimation of General Industrial Waste

The generation amount for general industrial waste was estimated using Formula A, as shown below. This formula uses the amount of each waste generated per employee in each industrial sector (See Main Report, Chapter 3.3.5 a6). The generation rate was calculated using data from the factory survey with Formula B.

Formula A: $\mathbf{IWG_{ij} = G_{ij} \times M_i}$

i	Code i sector from the 19 factory sectors
j	Type j waste from 29 types of waste (13 non-hazardous + 16 hazardous = 29 types)
IWG_{ij}	Generation amount (ton/day) of wastes generated j from the industrial sector i in the target study area
M_i	Number of employees in sector i in the target study area
G_{ij}	Generation amount (ton/day) per employee of waste j per sector i

The industrial waste generation amount G is calculated as shown in Formula B by the total amount of different industrial wastes in the sectors from the factory survey, using the total number of employees in that sector.

Formula B: $\mathbf{G_{ij} = GAF_{ij} / M_i}$

GAF_{ij}	Total amount of waste j (ton/day) from the factories surveyed by industrial sector i
M_i	Total number of employees (per person) in the sector i

a.3 Health-care Waste and Construction Waste

Health-care waste and construction waste was calculated as follows.

- The number of factories with attached clinics and the number of construction projects in the past 1 year were confirmed by contacting all PIM factories, as listed in part 1 and II of the SUFRAMA factory list, by telephone.
- The response by telephone from all the factories (334), revealed the ratio (37.1%) of factories with attached clinics (124), and the ratio (36.8%) of factories that carried out construction projects in the past 1 year (123).
- Based on each of these ratios, for all 440 factories currently in operation, the number with attached clinics (163 factories) and construction in the past year (162 factories) was determined.
- Of these, 9 factories with attached clinics and 10 factories with construction in the past year were visited to conduct a face-to-face survey of the generation amount according to 9 types of health-care waste and 4 types of construction waste.
- From the generation amount of each of these, the generation rates per factory with attached clinic and construction in the past year were calculated for each of the 9 types of health-care waste and 4 types of construction waste.

- The total amount of health-care waste and construction waste generated in PIM was calculated by multiplying each generation rate with the number of factories with attached clinic (163) and construction in the past year (162).
- The generation rate per employee is found by dividing the total amount of health-care waste and construction waste by the total number of employees at all 440 PIM factories in operation (which is 116,192 persons), which was used to estimate the future generation amount.

b. Current IW Generation Amount

b.1 Number of Factories and Employees

The following table is a summary of the 440 PIM factories in operation (in 2009) showing the number of factories and employees by sector, number of employees per factory, industrial output (2008) and industrial output per factory (2008).

Table 4-9: Summary of 440 PIM Factories

Factory Code	Description of Sector	Nos. of Factories	Nos. of Employees	Nos. of Employees per Factory	Industrial Output (IO) in mil. Real	IO per Employee in 1,000 Real
F01	Beverage (soft drink, alcoholic) and vinegars	15	2,975	198	178	60
F02	Leathers, skins and similar	0	0	0	0	0
F03	Printing and graphical company	16	843	53	70	83
F04	Electric, electronic and communication materials	121	37,765	312	15,974	423
F05	Wood	2	348	174	41	118
F06	Mechanical	28	5,464	195	1,399	256
F07	Metallurgy	47	6,003	128	3,712	618
F08	Non metallic minerals	6	698	116	269	385
F09	Furniture	5	445	89	48	108
F10	Paper, cardboard, cellulose	13	1,789	138	333	186
F11	Rubber	3	133	44	3	23
F12	Food products	13	538	41	111	206
F13	Chemical	34	1,355	40	5,305	3,915
F14	Plastic material products	75	9,625	128	3,138	326
F15	Textile	1	20	20	14	700
F16	Clothing, fabric and travel goods	2	589	295	38	65
F17	Transport material	33	43,937	1,331	13,620	310
F18	Construction	6	440	73	NA	NA
F19	Others	20	3,225	161	9,347	2,898
	Total	**440**	**116,192**	**264**	**53,600**	**463**

b.2 Current IW Generation Amount

In accordance with the above estimation method, the IW generation amount from PIM factories in 2009 was estimated at 628.9 tons per day, based on this study's results of four types of generation sources. The detailed breakdown of this is shown in the table below.

Table 4-10: IW Generation Amount in 2009

Industrial Waste (Name of generation source survey) *1	Generation Sources	Surveyed Generation Sources	Non-HIW (ton/day)	HIW (ton/day)	Total Generation Amount (ton/day)
General Industrial Waste (Factory Survey)	440	187	471.8	119.7	591.5
Health-care Waste (Medical Institution Survey) *2	163	9	0.2	0.2	0.4
Construction Waste (Construction Waste Survey)	162	10	37.0	0.0	37.0
Radioactive Waste (Radioactive Waste Survey)	9	7	0.0	0.0	0.0
Total Industrial Waste	**-**	**213**	**509.0**	**119.9**	**628.9**

Note *1: Only in reference to PIM factories targeted in this survey

*2: Does not include the generation amount of the one General Hospital surveyed

b.3 General Industrial Waste Generation Amount

In accordance with the above estimation method, the generation amount of general industrial waste per sector is estimated as shown in the table below.

Table 4-11: General industrial Waste Generation Amount per Sector (2009)

Unit: ton/day

Factory Code	Description of Sector	Nos. of Factories	Nos. of Employees	Non-HIW	HIW	All IW
F01	Beverage (soft drink, alcoholic) and vinegars	15	2,975	11.9	0.3	12.2
F02	Leathers, skins and similar	0	0	0.0	0.0	0.0
F03	Printing and graphical company	16	843	4.1	2.1	6.2
F04	Electric, electronic and communication materials	121	37,765	144.9	29.2	174.1
F05	Wood	2	348	1.3	0.4	1.7
F06	Mechanical	28	5,464	33.8	7.1	40.9
F07	Metallurgy	47	6,003	61.3	5.7	67.0
F08	Non metallic minerals	6	698	2.0	0.0	2.0
F09	Furniture	5	445	0.6	0.4	1.0
F10	Paper, cardboard, cellulose	13	1,789	80.8	2.5	83.3
F11	Rubber	3	133	0.5	0.1	0.6
F12	Food products	13	538	20.8	0.5	21.3
F13	Chemical	34	1,355	4.5	0.4	4.9
F14	Plastic material products	75	9,625	19.9	22.5	42.4
F15	Textile	1	20	0.1	0.0	0.1

F16	Clothing, fabric and travel goods	2	589	2.1	0.6	2.7
F17	Transport material	33	43,937	73.3	45.5	118.8
F18	Construction	6	440	1.6	0.5	2.1
F19	Others	20	3,225	8.3	1.9	10.2
	Total	440	116,192	471.8	119.7	591.5

Also, the general industrial waste generation amount for the separate non-production and production processes are shown in the following table.

Table 4-12: General Industrial Waste Generation Amount for the Separate Non-Production and Production Processes (2009)

Unit: ton/day

Factory Code	Description of Sector	Non production process		Production process		All IW
		Non-HIW	HIW	Non-HIW	HIW	
F01	Beverage (soft drink, alcoholic) and vinegars	11.0	0.1	0.9	0.2	12.2
F02	Leathers, skins and similar	-	-	-	-	-
F03	Printing and graphical company	0.2	-	3.9	2.1	6.2
F04	Electric, electronic and communication materials	50.7	9.0	94.2	20.2	174.1
F05	Wood	0.4	0.2	0.9	0.2	1.7
F06	Mechanical	8.3	3.4	25.5	3.7	40.9
F07	Metallurgy	12.3	2.3	49.0	3.4	67.0
F08	Non metallic minerals	0.4	-	1.6	-	2.0
F09	Furniture	0.5	0.1	0.1	0.3	1.0
F10	Paper, cardboard, cellulose	56.3	0.3	24.5	2.2	83.3
F11	Rubber	0.2	-	0.3	0.1	0.6
F12	Food products	-	0.2	20.8	0.3	21.3
F13	Chemical	0.5	-	4.0	0.4	4.9
F14	Plastic material products	7.7	20.6	12.2	1.9	42.4
F15	Textile	-	-	0.1	-	0.1
F16	Clothing, fabric and travel goods	0.7	0.2	1.4	0.4	2.7
F17	Transport material	16.5	1.7	56.8	43.8	118.8
F18	Construction	0.5	0.2	1.1	0.3	2.1
F19	Others	2.2	-	6.1	1.9	10.2
	Total	**168.4**	**38.3**	**303.4**	**81.4**	**591.5**

The generation amount of the 29 general industrial waste types classified into 13 non-hazardous (Non-HIW) and 16 hazardous (HIW) are given in the tables below.

Table 4-13: Non-HIW Generation Amount by Sector

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount
NH01	Kitchen waste (include waste from animal such as bone, skin, hair)	26.0
NH02	Wood	29.2
NH03	Paper	120.0
NH04	Plastic or polymers and resins	54.5
NH05	Textile and fiber	1.0
NH06	Animal oil, Vegetable oil	0.1
NH07	Rubbers and Leather	0.2
NH08	Ash/dust from coal-fired power plants, etc.	0.7
NH09	Metals and metal alloys such as aluminum, copper, bronze	163.6
NH10	Ceramic & Glasses	13.4
NH11	Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	1.7
NH12	Mixed waste (This code shall be applied in case wastes are discharged without separation.)	1.5
NH13	Others	59.9
Total		**471.8**

Table 4-14: HIW Generation Amount by Sector

Unit: ton/day

Waste Code	Type of HIW	Description of HIW	Generation Amount
HW01	Inorganic acid	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO4), Other inorganic acids	0.2
HW02	Organic acid	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids	-
HW03	Alkalis	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials	-
HW04	Toxic Compounds	including Hg, As, Cd, Pb, Cr, CN	2.8
HW05	Inorganic Compounds	Plating wastes, Picking waste, Sulphides, etc.	0.2
HW06	Other Inorganic	Asbestos, Slug, etc.	-
HW07	Organic Compounds	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.	18.9
HW08	Polymeric Materials	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.	1.0
HW09	Fuel, Oil and Grease	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc	20.0
HW10	Fine Chemicals and Biocides	Pesticides, Medicine, Cosmetic, Drugs, etc.	-
HW11	Treatment Sludge	Inorganic sludge, Organic sludge, Septic tank sludge, etc.	20.6
HW12	Ash from	---	0.2

	incinerator		
HW13	Dust and Air pollution control (APC) products	Soot and dust waste from incineration facilities, treating exhaust gas	1.0
HW14	Other Hazardous substance (besides HW01-HW13)	HIWs other than the above	34.4
HW15	Mixed Waste	---	14.7
HW16	Hazardous materials from Non-production process	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.	5.7
Total			**119.7**

4.2.3 Flowcharts Depicting Industrial Waste Management

The following management flowcharts of industrial wastes were estimated using the survey of generation sources (factory, medical institutions and construction waste surveys) and survey of waste service companies:

1. All Industrial Wastes (IW) generated from PIM (2009) — Figure 4-2
2. All General Industrial Wastes (IW) generated from PIM (2009) — Figure 4-3
3. General Non-HIW generated from PIM (2009) — Figure 4-4
4. General HIW generated from PIM (2009) — Figure 4-5
5. All Health-care Waste generated from PIM (2009) — Figure 4-6
6. Non Hazardous Health-care Waste generated from PIM (2009) — Figure 4-7
7. Hazardous Health-care Waste generated from PIM (2009) — Figure 4-8
8. Construction Waste generated from PIM (2009) — Figure 4-9

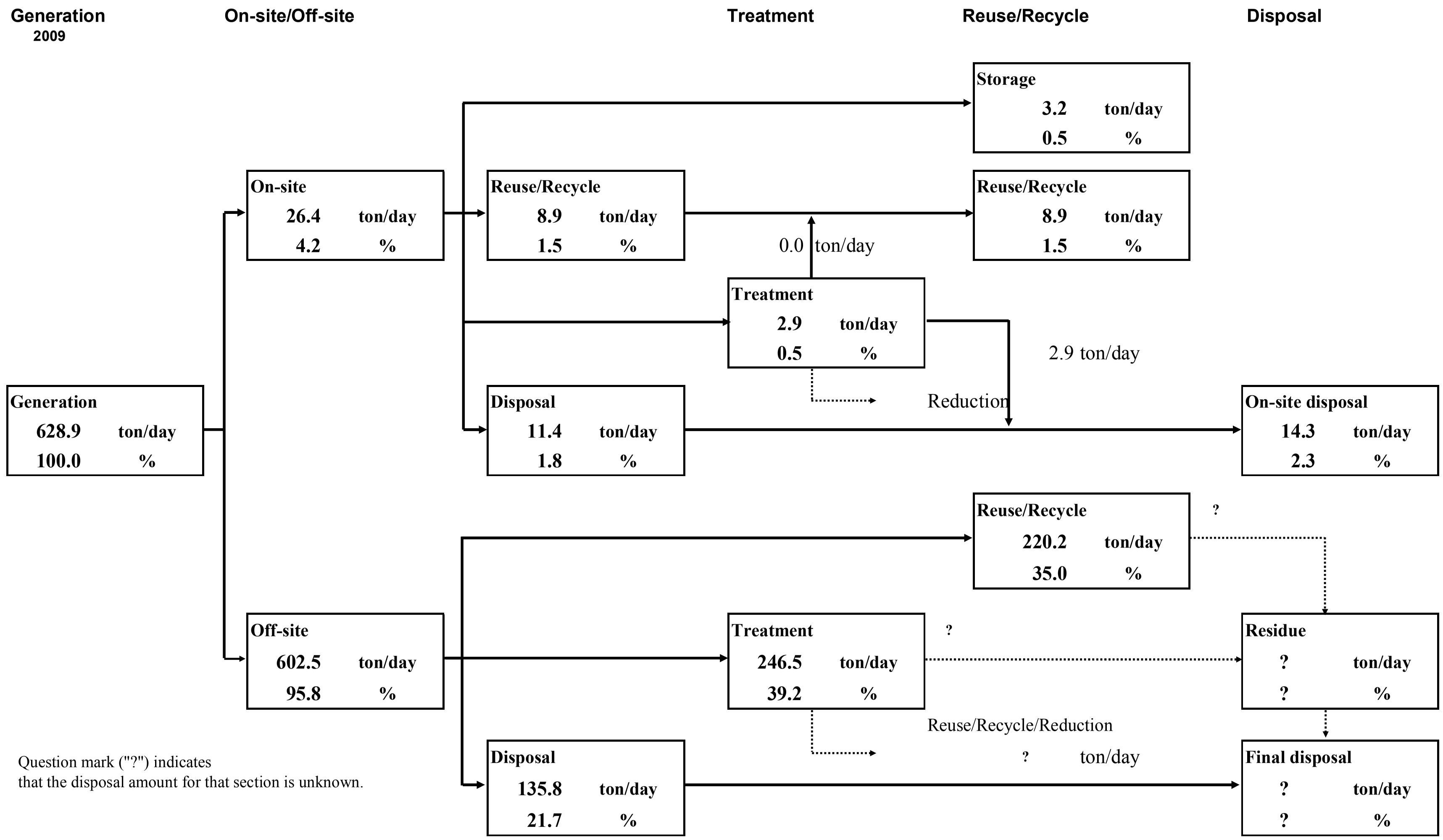


Figure 4-2: All Industrial Wastes (IW) generated from PIM (2009)

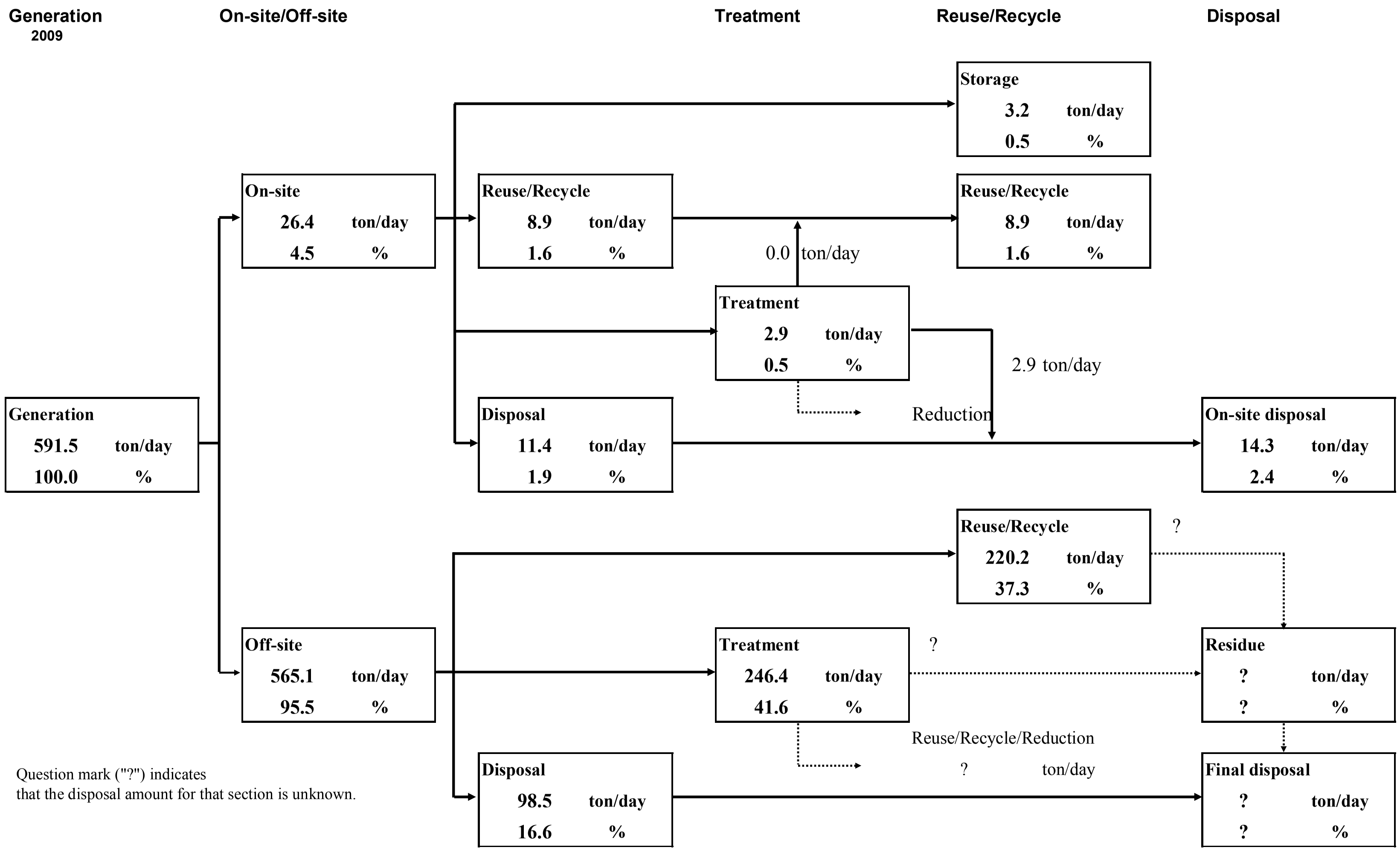


Figure 4-3: All General Industrial Wastes (IW) generated from PIM (2009)

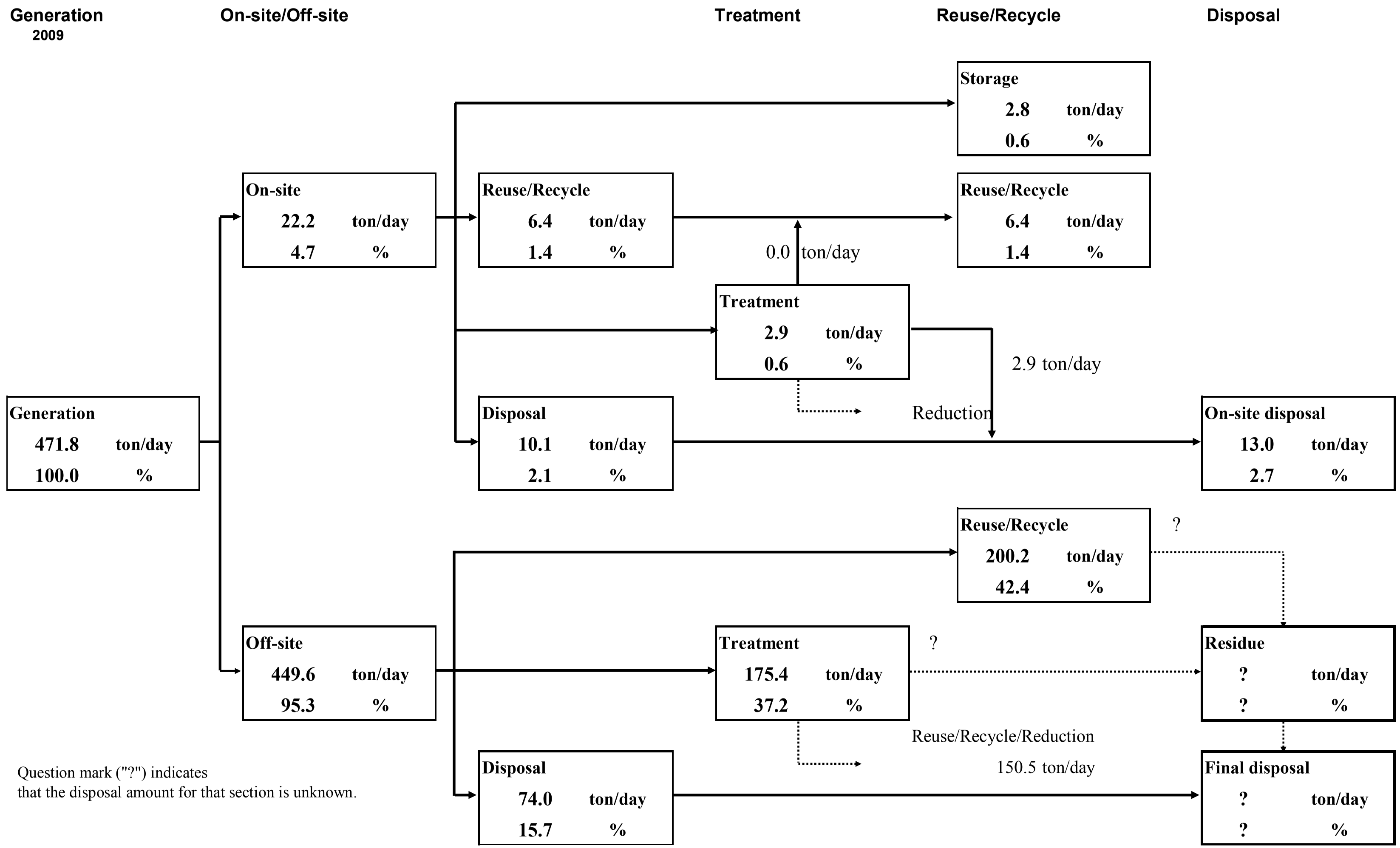


Figure 4-4: General Non-HIW generated from PIM (2009)

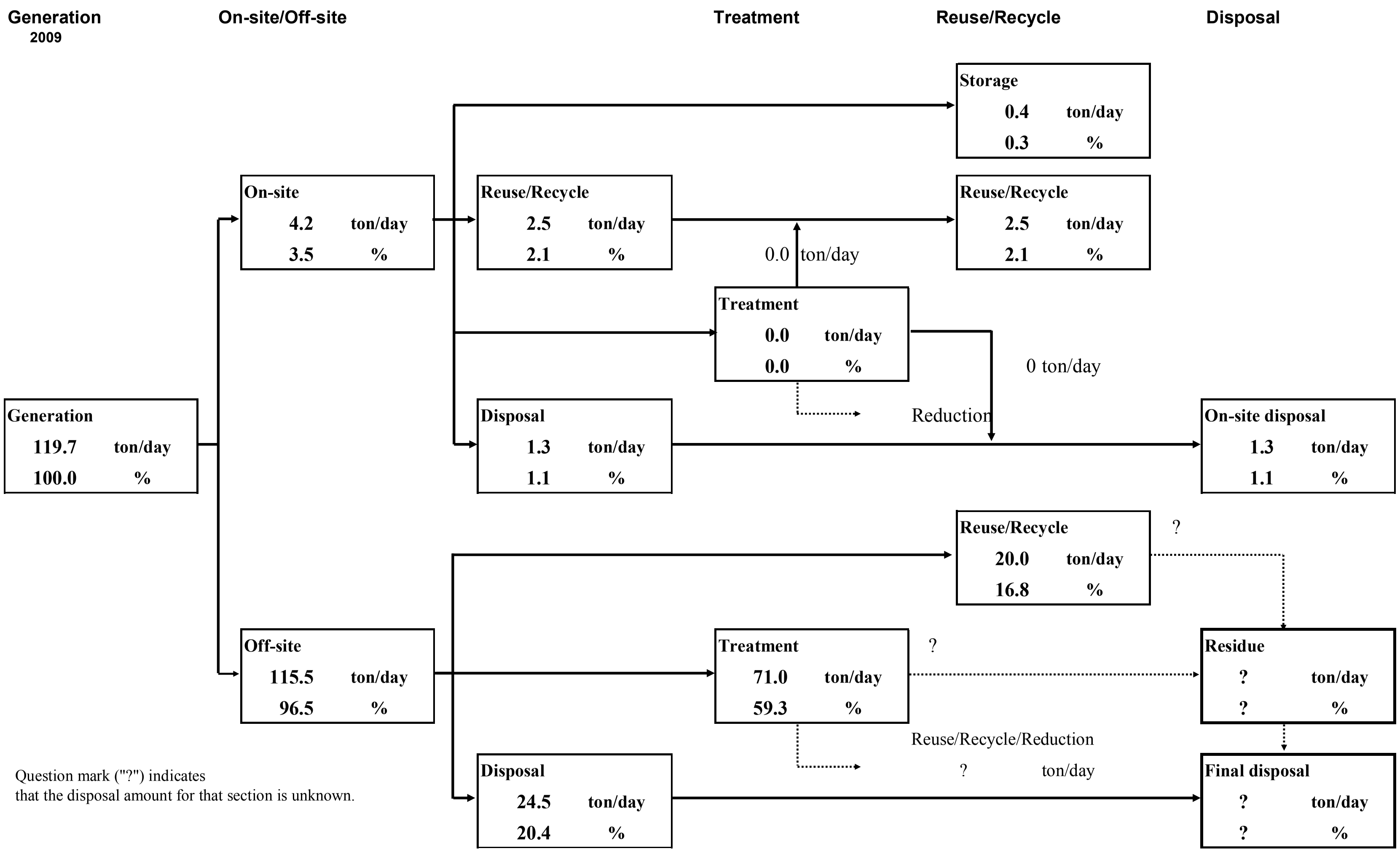


Figure 4-5: General HIW generated from PIM (2009)

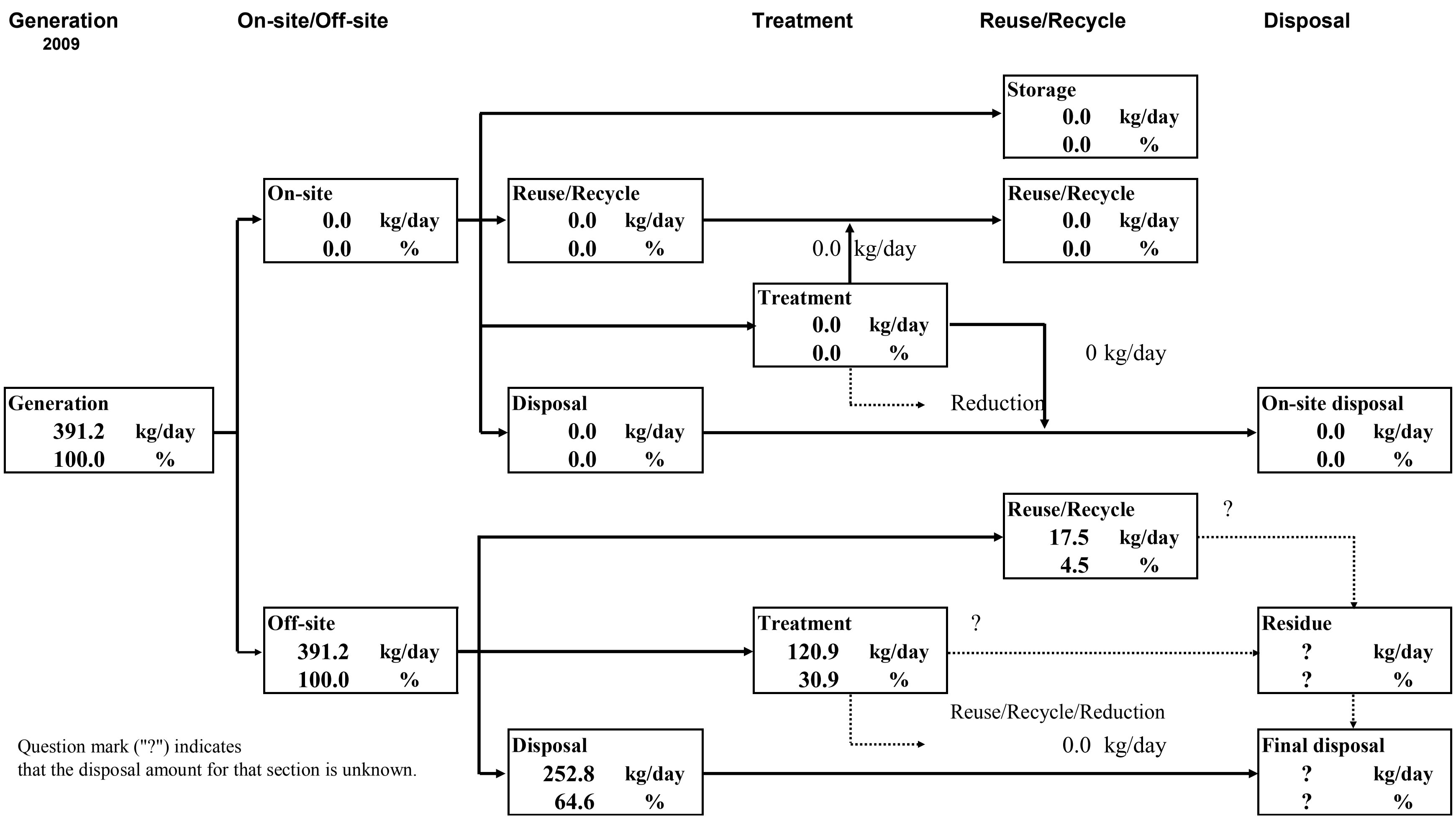


Figure 4-6: All Health-care Waste generated from PIM (2009)

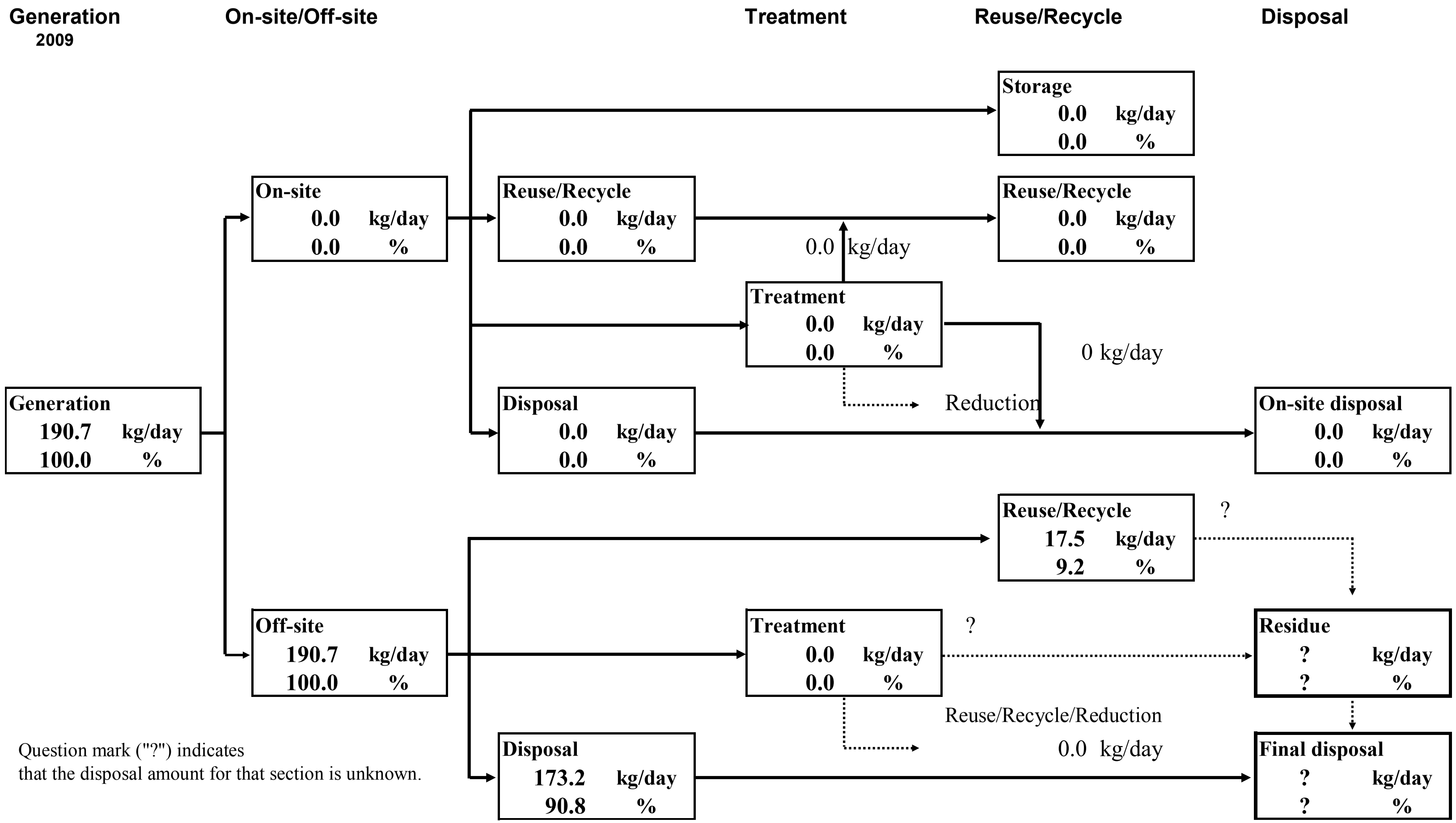


Figure 4-7: Non Hazardous Health-care Waste generated from PIM (2009)

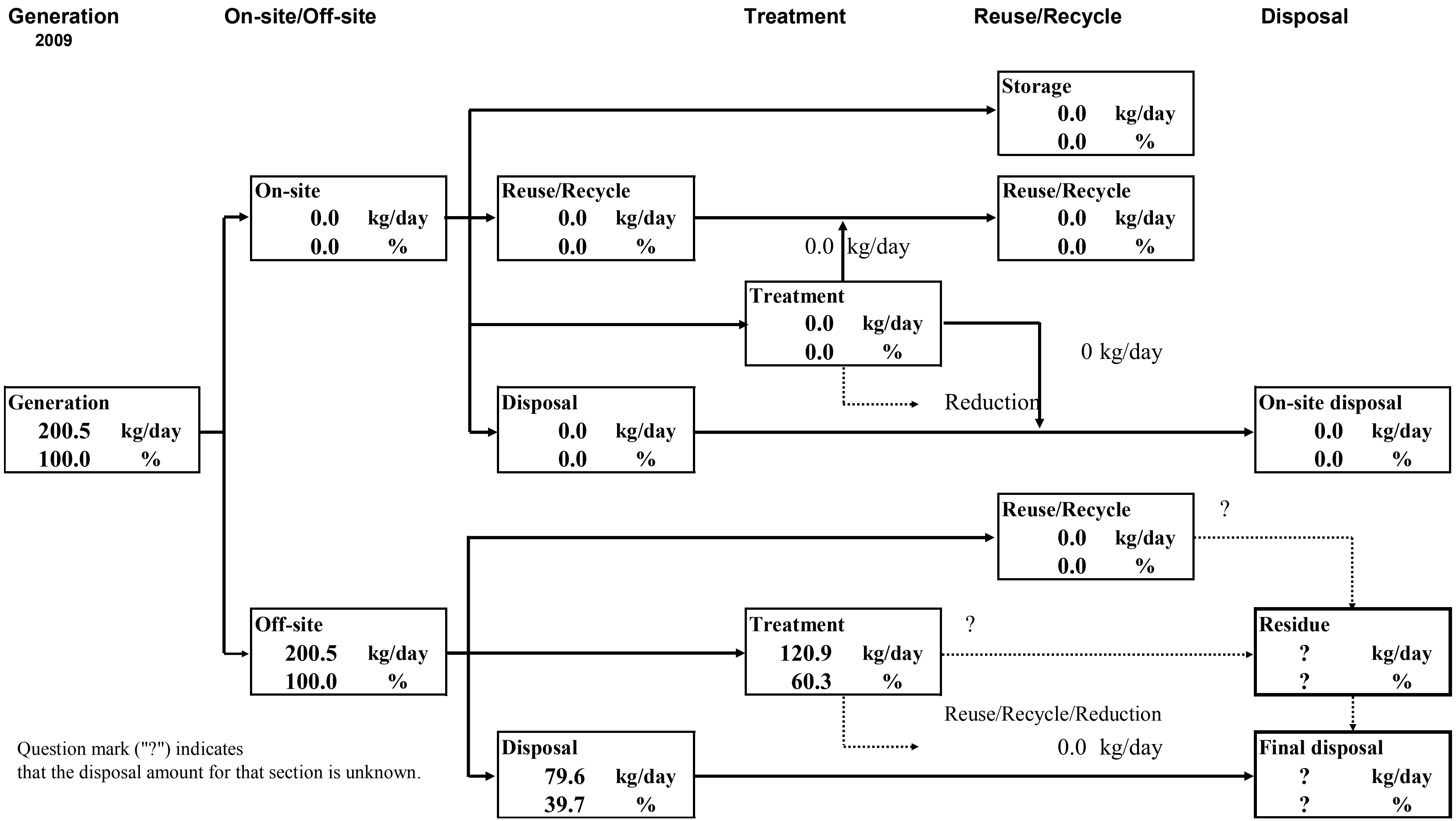


Figure 4-8: Hazardous Health-care Waste generated from PIM (2009)

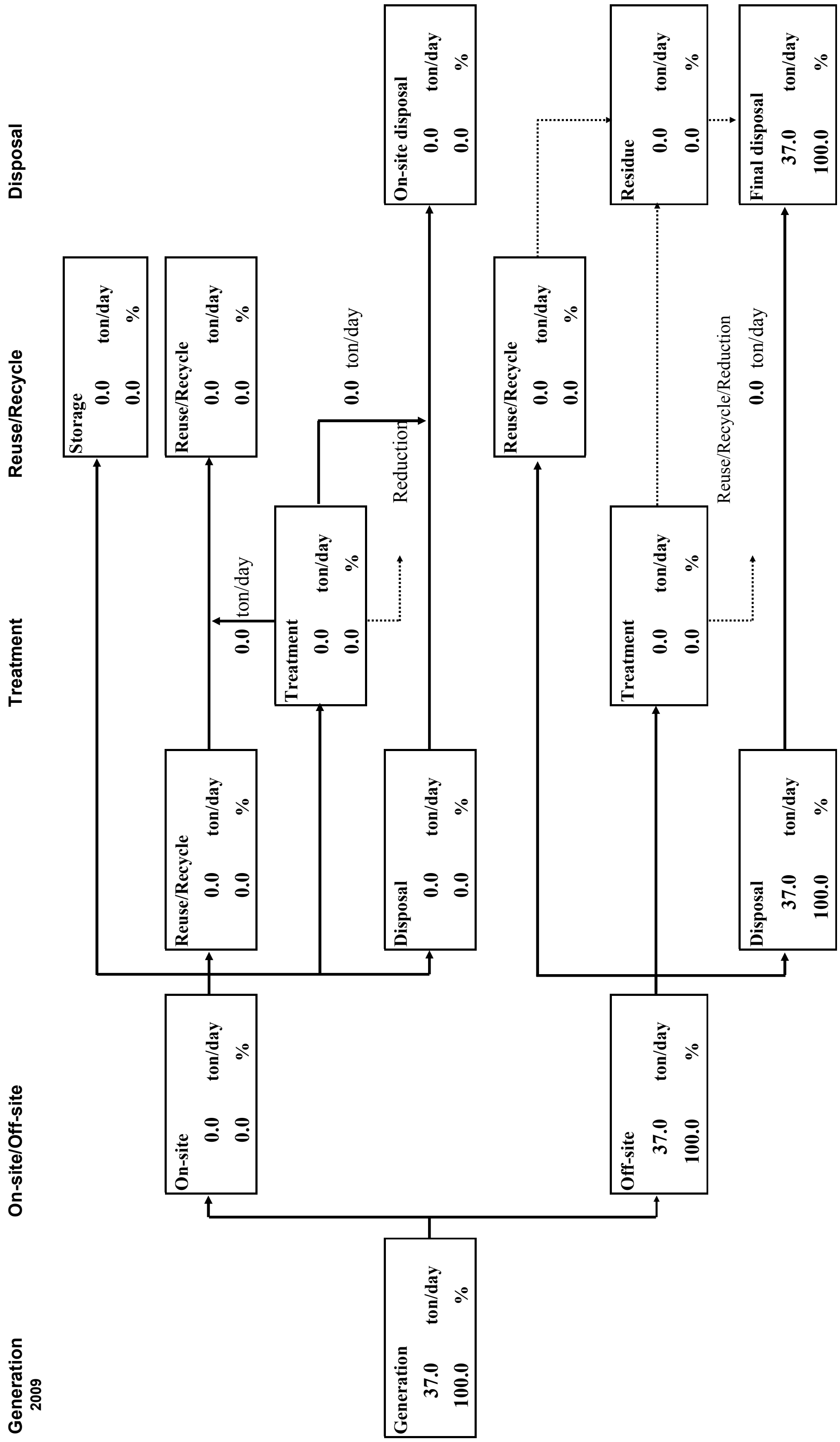


Figure 4-9: Construction generated from PIM (2009)

4.3 Current IWM in PIM

4.3.1 Current Conditions of Factories in PIM

a. Industry Scale

There are 475 factories in the factory list provided by SUFRAMA, and of those, 18 factories are located outside the target area, the MFZ. Since 17 of 457 PIM factories in the MFZ area were confirmed closed by the study, 440 factories are PIM factories operating in the MFZ.

There are a total of 116,192 people working in the 440 factories, which constitutes 6.8% of the population of Manaus in 2009. Also, the total production for the 440 factories in 2008 was 53.6 billion BRL (Brazilian Real). Accordingly, there is an average of 264 people working at each factory, so that yearly production per employee is 463,000 BRL.

The industry with the most number of factories is identified by Factory Code F04: Electric, electronic and communication materials, which makes up 27.5% of the total number. That is followed by F14: Plastic material products, which is 17% of the total. The industry with the highest number of employees is F17: Transport material, which is 37.8% of the total. Next is F04: Electric, electronic and communication materials, with 32.5% of the total. Accordingly, over 70% of all employees in PIM work in these two industries. Also, projecting from the production amount, these two industries account for 55.2% of the total amount in PIM.

According to the factory survey, the average lot size and building area at factories is 55,800 sq. meters and 15,300 sq. meters, respectively. Also, over one-third of the factories have medical clinics attached to them.

As shown above, the PIM factories are relatively large and mainly engaged in assembly production.

b. Pollution Control Facility

According to the factory survey, the installation rate of pollution control facilities is as follows.

Table 4-15: Installation Rate of Pollution Control Facility

Type of Facility	Installation Rate (%)
Incinerator	1.8
Industrial wastewater treatment facilities	27.5
Domestic wastewater treatment facilities	54.3
Dust collector	11.6
Air control facilities	12.4

As this chart shows, the rate of installation is not very high. However, these rates should be qualified for those cases where pollution control facilities, except for domestic wastewater treatment facility, are necessary and evaluated after a study of the production processes at the plant, etc. The rate of treatment facilities installed for domestic wastewater from non-production processes is 54.3%, which is relatively high in comparison to the other facilities. Nevertheless, a Manaus City regulation (Law No. 1,192/2007) established 31 December 2007, requires the installation of domestic wastewater treatment facilities for enterprises that have at least 40 employees. Even with a one-year grace period, this will obligate most factories to install facilities from 2009.

4.3.2 Industrial Waste Generation

a. Generation Amount

The total generation amount of industrial waste is 628.9 ton/day, of which 94.05% is general IW, followed by 5.88% of construction waste. Health-care waste was minimal at 0.06%. Also, no radioactive waste was generated.

The industrial sector with the largest amount of general industrial waste generated is F04: Electric, electronic and communication materials with 29.4% of the overall total or 174.1 ton/day. That is followed by F17: Transport material with 20.1% of the overall total or 118.8 ton/day generated. These two sectors make up about half of the general IW generated in PIM. The sector with the most HIW generated is F17: Transport material with 38.0% of the total or 45.5 ton/day generated. This is followed by F04: Electric, electronic and communication materials with 24.4% of the total or 29.2 ton/day generated. These two sectors account for 62.4% of the HIW generated in PIM. Furthermore, 65.1% of general IW is generated by production processes.

b. Waste Composition

Approximately 80% of all general IW is composed of Non-HIW. Of this non-HIW, the largest amount of waste generated is under waste code NH09: Metals and metal alloys such as aluminum, copper, bronze at 163.5 ton/day, which is 34.7% of all non-HIW. This is followed by NH03: Paper, at 25.4% of all non-HIW at 119.9 ton/day generated. On the other hand, for hazardous industrial wastes, those under waste code HW14: Other hazardous substances (besides HW01-HW13) were generated the most at 34.5 ton/day, which is 28.8% of the total HIW generated. This is followed by HW11: Treatment sludge, HW09: Fuel, Oil and Grease, and HW07: Organic Compounds, which are generated at 17.0% 16.7% and 15.8% of all HIW, respectively.

4.3.3 Factory Awareness of Waste Management

a. Industrial Waste Management Improvement Plan

According to the factory survey, in the future there will likely be a slight increase in the amount of industrial waste generated. Also, 62.6% (i.e. 109 of 174 factories) said there were currently problems with industrial waste management. The reasons given are as follows, in descending order.

1. High cost of industrial waste disposal: 57.8 % (63 of 109 respondents)
2. No facilities, or insufficient facilities, for the reuse or recycling of industrial waste: 48.6 % (53 of 109 respondents)
3. No service, or insufficient service, for industrial waste treatment: 37.6 % (41 of 109 respondents)

However, the majority of factories (78.8%) have not formulated a plan to improve management of industrial waste generated. Furthermore, a number of factories (70.2%) responded that they have no plan to promote 3R. From this it can be assumed that factories do not place a high value on controlling the wastes generated or recycling and reducing what they do generate.

b. Waste Inventory

All factories in PIM are obligated to submit a waste inventory. IPAAM has the legal right to instruct generators (factories) on the submission of the waste inventory (WI), and the legal obligation to aggregate, analyze and report the submitted WI to the federal government (IBAMA). Therefore, SUFRAMA has neither the right nor the obligation to engage on behalf of the government in dealing with WI. However, when SUFRAMA voluntarily requested the inventories from some factories, only about half complied—which is about 1/4 of the total number of factories. Again during the factory survey, 36.0% of factories replied that they do not submit the waste inventory. This infers that conditions for submitting the waste inventories need strengthening.

In addition, 27.5% of the factories replied that they were not required to submit a waste inventory, which points to a lack of recognition among the PIM factories regarding the waste inventories.

c. Separation

According to the factory survey, 14.0 % of factories do not separate their non-production process waste from their production process waste before discharge.

In relation, 18.8 % of factories reported that they mix their non-HIW and HIW for discharge. The reasons for this were given in the following order:

1. The amount is extremely small – 41.9 %
2. Difficulties to separate PP / HIW and PP / Non-HIW – 12.9 %

4.3.4 On-Site Waste Management

a. General Industrial Waste

a.1 Ratio of On-Site and Off-Site Management

The following table clearly shows that the ratio of on-site management in PIM is extremely low at 4.5% for all general IW, 4.7% for general Non-HIW and 3.5% for general HIW. Furthermore, the survey results of the 187 factories show that the difference between general Non-HIW and general HIW is practically negligent.

In comparison, the "Bangkok Industrial Waste Study" found that the proportion of on-site management was 29.9% for general Non-HIW and 56.3% for general HIW. Also, in Japan, the value for on-site management of IW (in Mie Prefecture, 2000) was 53.9%.

Accordingly, it can be said that the proportion of on-site management in PIM is extremely low. A large factor for this is quite likely the extremely low cost of off-site management.

Table 4-16: Ratio of On-Site and Off-Site Disposal

Study Area	Waste		Ratio of On-Site Disposal	Ratio of Off-Site Disposal
PIM	General IW		4.5 %	95.5 %
		Non-HIW	4.7 %	95.3 %
		HIW	3.5 %	96.5 %
Bangkok Metropolitan Area*1	Non-HIW		29.9%	70.1%
	HIW		56.3%	43.7%

Source: *1: The Study on Master Plan on Industrial Waste Management in the Bangkok Metropolitan Area and its Vicinity in the Kingdom of Thailand, November 2002 (Hereafter, Bangkok Industrial Waste Study)

a.2 Type of On-Site Management

a.2.1. Intermediate Treatment

As mentioned above, the proportion of on-site management in PIM is extremely low. Furthermore, there is almost no difference between on-site management in PIM (ratio of quantitative generation rate) of general Non-HIW and general HIW. An obvious characteristic of on-site management in PIM is that almost none of the factories are conduction intermediate treatment on premises. In particular, there is no treatment whatsoever of general HIW in the 187 factories of the Factory Survey.

As shown in the following table, the Bangkok study results show high prominence between non-HIW and HIW due to the high cost of off-site management, they reduce HIW by treating HIW as much as possible on-site (32.8% of the quantitative generation rate). In addition, Non-HIW was reused or recycled as much as possible (13.1% of the quantitative generation rate).

Table 4-17: Type of On-Site Management

Study Area	Waste		Intermediate Treatment Ratio	Reuse and Recycle Ratio	Storage Ratio	Final Disposal Ratio
PIM	General IW		0.5 %	1.6 %	0.5 %	1.9 (2.4*2)%
		Non-HIW	0.6 %	1.4 %	0.6 %	2.1 (2.7*2)%
		HIW	0.0 %	2.1 %	0.3 %	1.1 %
Bangkok Metropolitan Area*1	Non-HIW		0.9 %	13.1%	1.8 %	14.1 %
	HIW		32.8 %	1.6 %	0.4 %	21.5 %

Source: *1: Bangkok Industrial Waste Study

Note: *2: This ratio includes residue disposed after intermediate treatment

a.2.2. Reuse and Recycle

Although the proportion of on-site management is 4.5% of the generation amount, which is extremely low, the ratio of reuse and recycle in comparison to other on-site management methods is high at 1.6%. In particular, for on-site management of general HIW, only 3.5% is conducted of the total, but 2.1% of 60% of that goes toward reuse and recycle.

The Bangkok study results show the opposite, with a high ratio of reuse and recycle for general Non-HIW, and a very low ratio for general HIW.

a.2.3. Storage Ratio

The storage ratio, like that for intermediate treatment, is extremely low and hardly done. This fact is likely due to no generation of waste difficult to treat on- or off-site.

a.2.4. On-Site Final Disposal

Although the ratio for on-site management is extremely low, at 4.5% of the generation amount, the final disposal ratio is very high when compared to other on-site management methods, at 1.9%; this becomes 2.4% when residues from intermediate treatment are included. In particular, even though only 4.7% of all general Non-HIW is managed on-site, 2.1%--which is nearly half--is for final disposal.

In comparison to the Bangkok study results, those results showed the opposite with a high final disposal ratio of general HIW and comparatively low for general Non-HIW.

The detailed descriptions of this in descending order are: hazardous wastes are sludge, contaminated plastics and ink residue. In addition, fluorescent lights and batteries were also reported, but done so individually so the weight is unknown. Reports for non-hazardous, in descending order, are cardboard, non-recyclable wastes, and plastic lids. The results suggest these items are for storage waiting for off-site management.

b. Other Industrial Wastes

b.1 Health-care Waste

b.1.1. Condition of Clinics

The conditions of clinics attached to factories, as found in the medical institution survey, are as follows. None of the facilities were very large.

- Average number of clinic employees: 4.1 employees
- Average number of beds: 1.2 beds
- Average daily number of (out-)patients: 19 patients

b.1.2. Discharge Containers

RDC 306/2004-ANVISA regulates discharge containers according to different waste categories. For attached clinics at factories, the ratio which is observed is no more than half of this.

b.1.3. Storage

Of the facilities surveyed, one responded that the hazardous health-care waste and common waste they stored was mixed. Waste is stored in covered containers at 61% of the clinics. One-third of the clinics used cardboard boxes to store Group E (needles, scalpels, etc.) waste.

All of the facilities surveyed responded that they did not have cool storage facilities for certain Group A.3 (Body part) waste.

b.1.4. Intermediate Treatment and Disposal

Intermediate treatment and disposal of at the factories is not carried out.

b.1.5. Recycling

1/3 of the clinics recycle common waste valuables, such as paper and cardboard. Recyclers collect these valuables from each clinic on a regular basis.

b.1.6. Discharge

Waste is discharged from attached clinics according to prescribed categories.

Hazardous health-care waste and non-hazardous health-care waste are not mixed when discharged. Nevertheless, even though Group A, B and E and each class type, are stored separately, 22% of the clinics reported mixed discharge; the clinics' employees are the likely reason for this.

b.1.7. Training and Instructions

All of the clinics reported having written instructions concerning the handling of hazardous health-care waste within the clinic. Also, 100% said there is training/instruction for waste workers for handling hazardous health-care waste. Furthermore, 55% said that this training takes place once a year.

Employees at 88% of the clinics report receiving environmental educational training or information concerning hazardous health-care waste. At attached clinics, 242 people attend the classes on average.

b.1.8. Cooperation for Waste Management Improvements

All nine of clinics surveyed replied that they are able to cooperate on waste management improvement. Concerning efforts they would be willing to make for improvements, all replied "raising the environmental awareness of the public", seven (7) replied they could "minimize waste generation" and six (6) said through "discharging wastes neatly". Also, all replies confirmed that they would cooperate with national and municipal authorities toward waste management improvement.

b.1.9. Priority of Waste Management Improvements

A rise in waste management fees was indicated by 66% of clinics. 78% replied that waste management was a very high priority. Furthermore, 55% said they would welcome technical support from a government organization, whereas 33% were hopeful for financial support.

b.1.10. Intention to Improve Conditions for Collection and Disposal of Hazardous Health-care Waste

In order to improve the current conditions of collection and disposal of hazardous health-care waste, 38% of clinics answered "education to change people's bad habits", and 25% indicated "improvement of landfill operation".

Concerning who should bear the rise in cost for improvement of current collection and disposal conditions for hazardous health-care waste, clinics indicated the following: the State of Amazonas (22%), the City of Manaus (22%), and others (22%). Further, five clinics indicated that the greatest amount they would be willing to pay for collection and disposal was, on average, 145R$/month.

b.2 Construction Waste

b.2.1. Environmental License for Construction Projects

Of the total number of factories, about 60% had obtained environmental licensing to undertake a construction project.

b.2.2. Integrated Management Plan for Construction Waste

Of the total number of factories, about 60% had formulated a construction waste management plan as outlined in CONAMA Resolution 307.

b.2.3. Manifest (Monitoring the Disposal of Construction Waste)

Since Amazonas State does not require the use of a manifest for construction waste, it was used for only 22.9% (in item) of the discharged waste according to the construction waste survey.

b.3 Radioactive Waste

b.3.1. Generation of Radioactive Waste

According to radioactive waste survey and medical institution survey, responses from the factories on their use of radioactive materials, neither claimed to generate radioactive waste. It is therefore assumed, given that the facilities and equipment are relatively new, that radioactive waste is not generated from PIM.

b.3.2. Radioactive Materials Management in PIM

According to radioactive waste survey on 7 factories, the current conditions of radioactive materials management at PIM factories is give below.

- All seven of the factories have obtained licensing for the use of radioactive materials.
- The intended use of radioactive materials is process control, quality control and the like.
- Radiation sources are all shielded, with the exception of one location. At one location radioactive light is used as an irradiation lamp.
- All seven factories use radioactive light emitting equipment in controlled localities.

4.3.5 Off-Site Waste Management identified by Generation Sources Survey

The off-site waste managements are identified by the following generation surveys:

- General industrial waste by the factory survey;
- Health-care waste by the medical institution survey;
- Construction waste by the construction waste survey; and
- Radioactive waste by the radioactive waste survey.

a. General Industrial Waste

a.1 Collection

The following table shows the breakdown of the ratio of the amount of waste discharged from factories which is collected and transported by collection service providers.

Table 4-18: Breakdown of Collection Service Providers

Study Area	Waste		Factory (City) Ratio and Amount[*2]		Ratio of Private Enterprise and Amount	
			Ratio	ton/day	Ratio	ton/day
PIM	General IW		13.4 %	79.7	82.1 %	485.4
		Non-HIW	10.3 %	48.7	85.0 %	400.9
		HIW	9.3 %	31.0	70.6 %	84.5
Bangkok Metropolitan Area [*1]	Non-HIW		1.5%	95.8	68.6%	4,444.5
	HIW		0.1%	1.9	43.6%	665.4

Source: *1: Bangkok Industrial Waste Study

Note: *2: In PIM, only a very small amount is collected by the city (0.4%). In contrast, 100% was collected by the city in the Bangkok Industrial Waste Study.

From this table, the majority of general IW discharged from PIM factories is collected by private enterprise (WSCs: Waste Service Companies). It is possible to see the distinct difference between Non-HIW and HIW where most of Non-HIW is collected by WSCs. In contrast, a large amount of HIW is transported by the factory itself. In the Bangkok study, the factory itself transported almost none.

a.2 Type of Off-Site Management

a.2.1. Intermediate Treatment

The following table shows the breakdown (generation ratio) of off-site management based on answers from PIM factories. It is reasonable that the rate of treatment of HIW is higher than Non-HIW. However, the intermediate treatment rate of Non-HIW is extremely high when compared to that of the Bangkok study, where much of the hazardous waste is put through intermediate treatment (28.9% of the generation ratio) in an attempt to render it harmless or reduce the amount.

Table 4-19: Breakdown of Off-Site Management

Target Area	Waste		Intermediate Treatment Ratio and Amount		Reuse and Recycling Ratio and Amount		Direct Final Disposal Ratio and Amount	
			Ratio	ton/day	Ratio	ton/day	Ratio	ton/day
PIM	Industrial Waste		41.6 %	246.4	37.3 %	220.2	16.6 %	98.5
		Non-HIW	37.2 %	175.4	42.4 %	200.2	15.7 %	74.0
		HIW	59.3 %	71.0	16.8 %	20.0	28.4 %	24.5
Bangkok Metropolitan Area [*1]	Non-HIW		2.5%	159.5	64.8%	4,198.8	2.8%	95.8
	HIW		28.9%	444.1	14.2%	216.1	0.6%	1.9

Source: *1: Bangkok Industrial Waste Study

a.2.2. Reuse and Recycle

It is reasonable that rate of reuse/recycle of HIW is much lower (generation ratio of 16.8%) than Non-HIW (generation ratio of 42.4%). The findings from Bangkok show a very noticeable difference between the HIW and Non-HIW, where most of the Non-HIW discharged off-site (generation ratio of 64.8%) is reused or recycled.

a.2.3. Off-Site Final Disposal

The rate of direct final disposal of HIW is two times more than it of Non-HIW. It is a serious issue that rate of direct final disposal of HIW is quite high, 28.4%.

In comparison, the findings from Bangkok show a very noticeable difference between the HIW and Non-HIW, where the rate of direct final disposal of industrial waste is much lower than it in PIM, 0.6% for HIW and 2.8% for Non-HIW, especially HIW. In addition, the amount of residue after intermediate treatment and recycling could not be identified.

b. Other Industrial Wastes

b.1 Health-care Waste

b.1.1. Collection

All of the clinics receive collection service for both non-hazardous and hazardous health-care waste. With the exception of one clinic which receives service from SEMMA/SEMULSP, all clinics receive collection service of hazardous waste from private companies. 44% of clinics, however, do not pay fee for hazardous health-care waste. 55% indicated that they set the collection fee, although it varied from place to place.

Despite the fact that 33% of clinics indicated dissatisfaction with current collection service, there were no complaints from clinics in the past year received by collection service providers.

b.1.2. Monitoring of Hazardous Health-care Waste Disposal

All of the clinics indicated that a person has been assigned to be in charge of appropriate collection and disposal of hazardous health-care waste.

b.1.3. Disposal of Hazardous Waste

According to the medical institution survey two-thirds of clinics said that their waste went to an incinerator (120.9 kg/day in amount), whereas the remaining one-third provided no answer (79.6 kg/day in amount).

b.2 Construction Waste

b.2.1. Collection

99.3% (in weight) of construction waste generated was collected and transported by the collection companies that had been contracted for their services.

b.2.2. Recycling

The recycling amount was estimated to be 40 kg/day, which is less than 0.1% of the generation amount of the construction waste generated in PIM.

b.2.3. Treatment and Final Disposal

There was no treatment of the construction waste reported. All of the construction waste discharged was disposed of at the landfills. 96.9 % of construction waste is disposed of at the Manaus City landfill and the remaining at private disposal sites.

b.3 Radioactive Waste

There is no radioactive waste generation from PIM factories.

4.3.6 Off-Site Waste Management identified by Waste Service Company Survey

a. Waste Service Company Survey and Environmental Licensing

a.1 Environmental License Owners

There were 90 waste service companies (WSCs) surveyed from which the following results were found.

- Companies that have obtained environmental licenses: 67
- Companies that have not yet obtained environmental licenses: 23

a.2 Responses from WSCs by business sector and business conducted

The following table is based on the responses from 90 WSCs surveyed showing the business sectors divided into 4 categories of 1) collection and transportation, 2) intermediate treatment, 3) final disposal, and 4) reuse and recycling. Some companies were engaged in multiple practices, so the total number amounts to 127.

Table 4-20: Responses from WSCs according to business sector

Environmental License Ownership	1) Collection and transportation	2) Intermediate treatment	3) Final disposal	4) Reuse and recycling	Total
Yes	41	9	10	42	102
No	7	0	0	18	25
Total	48	9	10	60	127

a.3 Business Sector and Business Conducted (Management Amount) as analyzed by the Study Team

The following table shows the business sector of 67 waste service companies that have environmental licenses based on an examination by the study team with support from the local consultant.

Table 4-21: 67 WSC Environmental License Owners by business sector

Env. License Ownership	Collection and Transportation	Intermediate Treatment	Final Disposal	Reuse and Recycling	Not Classified*1	Total
Yes	26	24	0	21	4	75

Note: *1: The business sector could not be identified on the license. The licenses indicated the following: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide (1 comp.), 3. Retailer of wood products (1 comp.)

a.4 Size of WSCs (Number of Employees)

This survey revealed that number of (managerial and operational) at small or very small enterprises with less than 10 employees was 36% (i.e. 32 of 90 companies), but for the 23 enterprises without an environmental license, it was found that 21 were small or very small enterprises. On the other hand, of the 9 large enterprises with over 100 employees, the number of businesses that specialize in industrial waste management—thus excluding cement production, sale of construction materials and collection or disposal of municipal waste—was three. Presently, these large waste service companies are made up of three central groups.

b. Collection and Transportation

b.1 Amount Collected/Transported

Of the 90 WSCs surveyed, the total amount collected and transported, as shown in the following table, is 3,343 ton/day. This amount is some five times the total amount of 628.9 ton/day of industrial waste discharged from PIM according to the factory survey.

The two companies which are collecting over 300 ton/day are the two companies contracted to collect the municipal solid waste (MSW) of Manaus City. Thus, if this collection amount is taken to be MSW, the remaining collection and transportation amount is 1,071.5 ton/day. The following table summarizes the collection and transportation amount information obtained in the Off-site Survey (Survey of WSCs) and On-site Survey (survey of PIM generation sources: factories, medical institutions, construction). With the exception of the two companies that are clearly collecting MSW, the collection and transportation amount from the Off-Site Survey resembles that which was found for the On-Site Survey (Survey of generation sources) of PIM manufacturing, construction, and health-care waste.

Table 4-22: Comparison of Off-Site Survey and On-Site Survey Results for Collection and Transportation Amount

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount Collected/Transported	3,342.8	NA
2. Municipal Waste (2 companies)	2,271.3	NA
3. Industrial Waste	NA	591.5
4. Construction Waste	NA	37
5. Health-care Waste	NA	0.4
3 + 4 + 5	1,071.5	628.9

b.2 Conditions of Collection and Transportation

A large amount of recyclable material, such as plastic, paper and cardboard, and metals collected from MFZ is handled by large companies. In other words, the three major waste collection and transportation companies send their employees to waste centers located in the factories of large waste generating companies and have exclusive access to conduct separate collection of their recyclable materials. Based on this study, most used paper and 80% of scrap metal is collected by the three large collection and transportation companies. One of these large companies collects most of the waste plastic, and after separation and removal of foreign material, melts it will an extruder, cools it and makes pellets which are then used as raw material to make recycled plastic resin, and finally plastic products which are sold to manufacturing companies.

There is a factory that reuses waste paper in the study area, but no factory that reuses scrap metal, so with the exception of aluminum, most of the scrap metal is sent to companies in Sao Paulo, Rio de Janeiro and other places.

c. Intermediate Treatment

c.1 Intermediate Treatment Amount

There is a large difference concerning intermediate waste treatment between the WSC respondents (9 companies) and the business practices based on environmental licenses (24 companies). Thus, the amount of intermediate treatment was summarized based on the answers from companies as shown below. This table indicates only one WSC treats 90% of wastes for intermediate treatment.

Table 4-23: Breakdown according to Scale of Intermediate Treatment Companies based on the Responses of Waste service companies (7 companies *1)*2

Unit: ton/day

Scale (Intermediate Treatment Amount)	Intermediate Treatment Companies	Hazardous Waste	Non-Hazardous Waste	Total
Without License	2	0.2	0.7	0.9
1. less than 100ton/day	2	0.2	0.7	0.9
With License	5	41.9	265.6	307.5
1. less than 100ton/day	4	1.3	29.0	30.3
2. 100 to 300 ton/day	1	40.6	236.6	277.2
Grand Total	7	42.1	266.3	308.4

Note: *1: 7 out of 9 companies responded with their intermediate treatment amount

*2: In this study, the largest treatment company of health-care wastes was not included.

The results for intermediate treatment were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The result shows similar values.

Table 4-24: Comparison of intermediate treatment amount for the Off-site Survey and the On-site Survey

Unit: ton/day

Waste	Off-site Survey Results	On-site Survey Results
1. Total Amount of Intermediate Treatment	308.4	246.5
2. Non-HIW of the 1. (above)	266.3	175.4
3. HIW of 1. (above)	42.1	71.1

c.2 Conditions of Intermediate Treatment

There are 25 companies that have environmental licenses for intermediate treatment, but of those, many are actually conducting recycling operations. One waste treatment company is conducting incineration service, and is treating a large amount of waste. The only cement factory in Amazonas State is conducting co-processing in its cement kiln. Based on the study data, the waste primarily being treated/used is waste tires (300 ton/month), waste molding sand (95 ton/month), and sludge from plating (30 ton/month). Mixing in the materials yard, they also input waste to the kiln (into a suspension pre-heater hatch), but the waste is brought up by a conveyor not an elevator and also requires manpower. Also, there is a little substitution of fuel with waste oil, the authentic treatment/reuse is happen from now.

d. Reuse/Recycle

d.1 Reuse/Recycle Amount

82% (14 of 17 WSCs replied) are small companies which manage less than several ton of waste per day.

The results for reuse and recycle amount were summarized for the off-site (survey of WSCs) and the on-site (PIM generation sources: factories, medical institutions, construction projects) survey results. The off-site survey and the on-site survey results show similar values.

Table 4-25: Comparison of Survey Results (Reuse/Recycle Amount) for WSCs and PIM Generation Sources (factories, medical institutions, construction projects)

Unit: ton/day

Waste	Survey Results of WSCs	Survey Results of PIM Generation Sources
1. Total Amount of Reuse Recycle	178.9 (487.3)	220.2 (466.7)
2. Non-HIW of 1. (above)	167.8 (434.1)	200.2 (375.6)
3. HIW of 1. (above)	11.1 (53.2)	20.0 (91.1)

Note *1: The number in parentheses are the total of intermediate treatment amount and reuse/recycle amount

d.2 Conditions of Reuse/Recycle

There are 60 companies that are conducting the reuse and recycling of waste, including those which do not possess an environmental license. However, upon examination of the environmental licenses themselves, there were 17 companies. Of these 17, there were 11 that had an environmental license code other than for waste management. All of them were conducting the reuse and recycling of industrial waste. Even for those companies that do have licenses, there are many uncertainties concerning their activities. The reason for this is that the environmental license is only specified under "(industrial) activities that have potential environmental impact" for waste treatment and recycle (30＊＊) subcategory 3004 for treatment and recycling of palettes, and 3005 for recycling waste paper products and cardboard, whereas the other activities are ambiguous concerning this point.

The types of waste that are reused/recycled in the study area are limited to: used lubricating oil, used molding sand, aluminum scrap, waste paper, used paint, and used ink cartridges from printers, etc.

e. Final Disposal

e.1 Final Disposal Amount

Out of the WSCs surveyed, nine responded that they conduct final disposal activities. However, the results of examining the environmental licenses of the companies that responded revealed that none of them have environmental licenses for final disposal. Also, IPAAM reported that there is no landfill in MFZ, including the Manaus city landfill, which is not licensed for final disposal. Therefore, the following table summarizes the amount of final disposal based on the respondents.

Table 4-26: Breakdown of the Scale of Final Disposal Amount based on the WSC respondents (6 companies *1)

Unit: ton/day

Scale (Final Disposal Amount)	Final Disposal Company	Hazardous Waste	Non-Hazardous Waste	Total
Without License	6	8.0	2,250.1	2,258.1
1. less than 100 ton/day	4	0.0	3.0	3.0
2. more than 300 ton/day	2	8.0	2,247.0	2,255.0
Grand Total	6	8.0	2,250.1	2,258.1

Note *1: 6 of 9 companies responded their collection amount

In the above table, the 2 companies that conduct final disposal of more than 300 tons/day are the two disposal companies contracted to collect municipal waste in Manaus City and dispose of it using the city landfill. The amount collected and transported by these two companies is 2,271.3 ton/day, which is largely consistent with the final disposal amount. Therefore, the table above does not include the final disposal amount revealed in the On-site Survey of manufacturing (industrial), construction and health-care waste from PIM, which is 135.8 ton/day (98.5 + 37.0 + 0.3, respectively).

It is assumed that this amount of waste is being disposed of in landfill sites other than the Manaus city landfill.

e.2 Conditions of Final Disposal

Final disposal operation of the WSC respondents (9 WSCs) is categorized into the following categories.

Table 4-27: Type of Final Disposal Operation by WSC Respondents (9 WSCs)

Industrial + Health-care + Construction Waste	Construction Waste	Municipal Solid Waste	Wastewater Disposal	Total
1	3	2	3	9

There are two companies which are contracted by Manaus City that collect and dispose common waste. These two companies also collect and dispose medical and construction waste from factories in the industrial districts, etc. However, without their own final disposal sites, they must use the Manaus City final disposal site. There are three companies that dispose of construction waste which also use the Manaus final disposal site. Only one company has its own final disposal site for industrial waste, but the problem is that it began part of its operations before receiving approval for an (operation) environmental license from IPAAM. The EIA for this facility was not approved in a public hearing and has been ordered to suspend operations by the Amazonas State Attorney's Office.

4.4 Current IWM Issues in PIM

The current issues of industrial waste management in PIM from various perspectives, such as management at waste generating factories, management of waste discharged from factories and management by government administration of both, is given below.

4.4.1 IWM Issues at Factories (Generation Sources)

a. Extremely low on-site waste treatment at factories

A significant characteristic at present of IWM in PIM is that most wastes generated are disposed of off-site, as shown in the table below. All health-care waste and construction waste generated is disposed of off-site.

Table 4-28: Comparison of On-site and Off-site IW Disposal Ratio

Study Area	On-site disposal (%)	Off-site disposal (%)
1. PIM Industrial Waste	**4.2**	**95.8**
General Industrial Waste	4.5	95.5
Health-care Waste	0.0	100.0
Construction Waste	0.0	100.0
2. Bangkok Metropolitan Area, Thailand (2002)	**35.0**	**65.0**
3. Mie Prefecture, Japan (2000)	**53.9**	**46.1**

The reason for such a low rate of on-site waste disposal is the drastically low cost of off-site disposal. In particular, it is probably due to the fact that the Manaus City final disposal site, where most IW is sent, does not charge a disposal fee. Accordingly, the conditions are not such that readily promote 3R activities in factories. As a result, the reuse/recycle rate is a mere 1.4% of waste generated. Notably, the reuse/recycle rate of construction waste is only 0.1%, including off-site disposal, so that 96.9% of waste generated is disposed of free of charge at the Manaus city landfill.

In comparison, the disposal rate at a Japanese factory (in Mie Prefecture) at 53.9% is 13 times that of PIM, and even the Bangkok metropolitan area was 35.0% or 8.3 times that of PIM. The reason for the high on-site disposal rate is the high cost of off-site waste disposal, so the factories use 3R measures as much as possible to reduce the off-site disposal of wastes as much as they can. In Japan, progressive factories are reducing waste generation, with some even achieving Zero Emission, where no waste is discharged from the factory.

In order to dispel concerns of environmental pollution caused by industrial wastes generated from production activities in PIM, the first step is promoting 3R in factories, which calls for constructing a system so that wastes are discharged as little as possible from factories.

b. Lack of incentive to construct a system for appropriate on-site waste management

According to the factory survey, it is assumed that there will be a slight increase in industrial waste generated at PIM factories in the future. However, the majority of factories (78.8%) have not formulated a management improvement plan for the wastes generated. Furthermore, many factories (70.2%) are without a plan to promote 3R. In other words, from this it would seem there is a lack of commitment toward improving on-site waste management and reducing waste discharge.

In order to construct a system for appropriate industrial waste management, it is important to (1) reduce the generation of industrial waste as much as possible, (2) reuse and recycle IW that is generated to the greatest extent possible, and (3) the waste that is generated despite the previous two efforts is appropriately treated and disposed. Thus, the first measure is to establish a system of appropriate on-site waste management by reducing waste generation and conducting reuse or recycle on-site, and then to establish an appropriate treatment and disposal for IW that is discharged at off-site.

Nevertheless, under current conditions where most industrial waste that is discharged can be disposed of free of charge at the landfill, there is no incentive to promote 3R of IW at factories that generate waste or appropriate disposal of wastes generated.

c. Insufficient understanding of off-site disposal of IW

The first step to "constructing an appropriate system of industrial waste management" is to correctly understand actual disposal of IW. As long as these conditions and the issues surrounding them are left unclear, constructing such a system is not possible. However, due to the following factors, the actual disposal of IW in PIM remains in need of clarification.

c.1 Factory lack of interest in off-site disposal

The responsibility for appropriate disposal of industrial waste lies not only with waste service companies (WSCs) consigned to dispose of the discharged wastes, but also with the discharging entity. Accordingly, if the residues from inappropriate disposal cause environmental pollution, assumption of responsibility is extended to the factory which discharged the waste. In fact, when large-scale illegal dumping was discovered in the state of Para, next to Amazonas, in cases where the discharger could not be specified, the federal government also placed liability on the discharger for the clean-up fee.

Not limited to such instances, as shown in Figure 4-2, a survey of waste service companies was conducted in addition to the factory survey of dischargers, yet it was not possible to clarify the final destination of all wastes discharged. Notably, along with intermediate treatment and reuse/recycle, it was not possible to clarify the final destination of residues. Namely, this means that the factories which discharge the waste are not sufficiently aware how waste they've discharged is treated or where it is taken for final disposal. It is suggested that the cause for this is a lack of concern by the factories regarding off-site disposal.
It will be necessary for IPAAM to collaborate with SUFRAMA in raising the interest of those discharging waste in appropriate off-site disposal through guidance and education measures.

c.2 Lack of an established waste manifest system

A significant factor in the inability to clarify the final destination of all wastes discharged, in addition to the apparent faltering interest in off-site disposal shown by factories as mentioned above, is that the State of Amazonas has no established waste manifest system. Despite the obligation in the State of Amazonas to produce and submit waste manifest-related paperwork, IPAAM has not specified a format that should be used for a waste manifest. As a result, generators and receptors each report to IPAAM using their own forms. For IPAAM, they receive these forms and file them for environmental (operation) licensing, but there is no database set up for their original purpose of waste management. Thus, the waste manifests which are submitted are hardly used for management or analysis.

IPAAM regards establishing a waste manifest system as an urgent issue.

c.3 Insufficient submission of waste inventories

The first imperative of CONAMA Resolution 313 is to understand the current conditions of industrial waste management in order to construct an appropriate IW management system for the State environmental agencies in charge of IW administration. For that reason, factories are requested to submit waste inventories. This calls for each State environmental agency to manage and analyze these waste inventories, grasp the actual conditions of IWM, and formulate a plan to resolve particular problems that are revealed.

The State of Amazonas is enforcing CONAMA Resolution 313 by obligating all PIM factories to submit a waste inventory. Nevertheless, it remains that only 1/4 of factories submit one. Lack of compliance by factories is naturally the cause, but it is also due to a lackluster administrative system of guidance and enforcement. Furthermore, as follows, another factor is the inadequate system to manage and apply the waste inventories that are received.

c.4 Insufficient management of waste inventories

In the State of Amazonas, CONAMA Resolution 313 went into effect in October 2002, obligating PIM factories to submit a waste inventory. In response, every year about 1/4 of factories submit the waste inventories to IPAAM, the State environmental agency, and SUFRAMA, the superintendent of the designated industrial area.

CONAMA Resolution 313 also calls for IPAAM, the State environmental agency which manages and analyzes the submitted inventories, and IBAMA, the Brazilian Institute for the Environment and Renewable Natural Resources, to collaborate within 3 years (by October 2005) to formulate a "State Industrial Waste Management Plan". However, at IPAAM, the waste inventories received are filed as is, and there is no database for analysis. Thus, the waste inventories that have been submitted are, for the most part, left neither managed nor analyzed. As a result, not only is there no state industrial waste management plan, but the actual conditions of industrial waste disposal remain unclear. Hence, IPAAM is hastening to prepare a system to manage and analyze the waste inventories.

SUFRAMA enters the waste inventories they receive, as shown in Table 4-8: Generation Rate from Responding Factories, into a database and calculate the generation amount. However, there is zero input concerning how to waste managed of on-site, how much is discharged off-site or how it is disposed. In addition to a general need for SUFRAMA to strengthen its ability to manage and analyze the inventories, the major reason for this is likely that the elaborate reporting forms and procedures (such as the waste types, disposal method, units and so forth) prescribed by CONAMA Resolution 313 are exceedingly complex for those expected to comply. For that reason, at least in the State of Amazonas, a system should be set forth which establishes one specified waste inventory format, which, once submitted from factory, is promptly entered into the database.

d. Use of pollution control facilities

According to the factory survey, the use of preventive devices for air pollution and industrial effluent treatment facilities is quite low at 13.5% and 26.6%, respectively. Nevertheless, the necessity of such devices should be duly appraised and evaluated based on an investigation into the manufacturing processes of the factories. Therefore, the current installation rate cannot be evaluated based on these figures alone.

On the other hand, the installation rate of treatment facilities for effluent (wastewater) from non-manufacturing processes is 54.3%, which is relatively high in comparison to the rate for industrial effluent treatment facilities. However, a Manaus City regulation established on

December 31, 2007 (Law No. 1,192/2007) obligates any business with 40 or more employees to install treatment facilities for general effluents. Taking into consideration a 1 year grace period, over half of the factories have been obligated to install these devices since 2009. The PIM factories are relatively large in scale with the average number of employees of 264 persons. Pursuant to this, there is no small number of factories that are operating in defiance of the city regulation and polluting the *igarape* with effluent.

In order to improve these circumstances, the Municipal Secretariat of the Environment (SEMMA) will need to collaborate with IPAAM to bring offending factories into compliance with the regulation. Also, IPAAM will have to conduct monitoring at the factories, investigate the manufacturing processes and so forth, and scrutinize the necessity for pollution control facilities other than those for general effluent treatment, giving advice on countermeasures to carry forward regulation. In addition, it is necessary for SUFRAMA and IPAAM to collaborate to gain an understanding factories' current use of pollution control facilities and proceed to obtain environmental licensing for PIM as called for by the State Public Ministry.

4.4.2 Off-Site IWM Issues

a. Insufficient understanding of actual conditions concerning waste service companies

The most pressing issue to do with off-site industrial waste management is the fact that actual conditions concerning waste service companies (WSCs) are largely unknown.

a.1 Uncertainty as to the number of WSCs

Waste service companies are required to obtain an environmental license from IPAAM in order to carry out their operations. Therefore, IPAAM is managing WSCs through the issuance of operation licenses. According to the JICA preliminary study team dispatched to set down the project specifications for the current study, the list given to them by IPAAM listed 90 WSCs. Thus, based on that list, this study would carry out a survey of 90 WSCs.

However, at the start of the survey of waste service companies, the list of WSCs given by IPAAM contained 84 companies. The local consultant (OPCA) consigned in the study contacted all 84 companies on the IPAAM WSC list to request their cooperation with the study, but the number of companies actually carrying out these services was limited to 63% of the total, or 53 companies. Furthermore, the number of companies the study was able to survey was 35.

Consequently, the local consultant (OPCA) met with factories and WSCs and, based on what they learned, independently located 55 waste service companies and surveyed a total of 90 companies. The 90 companies that were surveyed are arranged in the table below to show those which had obtained an environmental license for these operations.

Table 4-29: Possession of Environmental (Operation) License among 90 WSCs Surveyed

WSC Classification	Number of WSCs
With Environmental License	67*1
Without Environmental License	23*2
Total	90

Note *1: Of these 67 companies, 35 were on the IPAAM WSC list, and 32 were added by the local consultant

*2:These 23 companies were found by the local consultant

As shown above, the survey of waste service companies showed that the number of companies in the State of Amazonas working on waste services was not fully understood. It also revealed that there were a number of entities conducting waste services without having obtained the proper license.

a.2 Discord between WSC operations and environmental licenses

The replies received from WSCs concerning their operations are shown in the table below. Multiple answers were allowed according to a company's operations so that the total amounts to 127.

Table 4-30: WSC Replies concerning Type of Operation

Possession of Environmental License	1) Collection / Transportation	2) Intermediate Treatment	3) Final Disposal	4) Reuse / Recycling	Total
With	41	9	10	42	102
Without	7	0	0	18	25
Total	48	9	10	60	127

The study team worked with the local consultant regarding the 67 WSCs with licenses that were surveyed to look over the descriptive content of the environmental licenses. As a result, the following table shows the categorization of work conducted by those licensed WSCs accordingly.

Table 4-31: Categorization of Waste Services of 67 Companies with Environmental Licenses

Possession of Environmental License	Collection / Transportation	Intermediate Treatment	Final Disposal	Reuse / Recycling	Unable to categorize *1	Total
With EL	26	24	0	21	4	75

Note: *1: An actual visual check of the licenses was unable to confirm the corresponding work conducted by the WSCs; the content of the licenses were as follows: 1. Distribution and supply of water (2 companies), 2. Spray and cleaning with insecticide, 3. Retailer of wood products

It is clear from the 2 tables above that the description of work permitted in the environmental license diverges greatly from work actually done. Furthermore, other problems as follows were ascertained in relation to WSC licenses.

- There is no final disposal site with an environmental license, including the Manaus city landfill, in the State of Amazonas. There are 9 companies carrying out final disposal operations regardless.
- A case where waste treatment such as incineration are carried out although the environmental license permits waterworks but not other such waste treatment activities. In this case, it is clear that the WSC should obtain a license.
- Of the 17 companies in the reuse/recycle category, 11 companies are under an environmental license code other than waste services. Specifically, companies whose main activities are paper or aluminum manufacturing are reusing or recycling waste as part of their activities. In such a case, a license for the reuse/recycling of waste should be obtained in addition to their current license, or a new licensing structure should be looked into.
- A large number of activities classified as intermediate treatment should be considered reuse/recycling.

a.3 Presence of unregistered entities

As previously stated, there are a number of currently unregistered entities conducting waste services without having obtained an environmental license. In this study, at least 23 were found. Further, given that the number of companies that have obtained a license and are operating waste services is unclear, conditions are not conducive for the government administration responsible for managing waste services to sufficiently regulate these unregistered entities. Moreover, the WSC users (i.e. factories) are not provided information from the government not only about which companies are accountable, but also information on which companies have obtained the proper environmental license.

As can be seen from this, there are at present various problems with the system to register WSCs. A large part of the problem is that the current environmental licensing system has waste services dispersed across a wide range of activities. As such, IPAAM must quickly construct a uniform management structure for WSCs and develop a corresponding database.

b. Secure Final Destination

b.1 Final disposal site without operation license

Based on the results from the survey of waste service companies, 9 companies are involved in final disposal activities. However, there is no final disposal site in the State of Amazonas which has obtained an environmental license, including the municipal landfill. At the end of 2009, there are 2 locations, one owned by Manaus city and another privately held location, where industrial waste from PIM is brought for final disposal. Nevertheless, neither of these possesses an operation license for final disposal.

Regardless of this situation, as shown in Figure 4-2 the final destination of at least 21.7% or more of the industrial waste generated is the landfill. Taking the unclear circumstances of disposal of residues generated from intermediate treatment and reuse/recycling into consideration, a great amount of industrial waste is being disposed in a landfill without an environmental license. In other words, because a landfill without an environmental license is the primary final destination of industrial waste generated in PIM, most of the PIM factories do not satisfy the conditions required for ISO 14000.

Meanwhile, even though the construction and operation of a licensed landfill site has been a considered for PIM waste management for many years, little progress has been seen. In order to build a robust IWM system for PIM, it is necessary for stakeholders to come together and proceed to construct a final disposal site with an operational license as soon as possible.

Construction of a final disposal site will become possible for the first time through a process that includes site selection, environmental study, EIA, public hearing, and consensus building with residents. Thereby, a considerable amount of time is required prior to construction. Until then, the question of how to secure final destination is be a distinctly large issue for forming an appropriate waste management system for PIM.

b.2 Promoting Co-processing

Co-processing is the use of waste as raw material, as a source of energy, or both to replace natural mineral resources (material recycling) and fossil fuels. Instances where no residues are generated are regarded as Final Destination. In the target study area, co-processing activities are undertaken where one company is manufacturing and selling asphalt filler mixed with 5% waste in addition to the cement factory. That seller, however, did not agree to comply with the WSC survey, so specifics are unclear.

Meanwhile, the amount of waste put toward co-processing by the sole cement factory located in the MFZ is considered extremely limited at 5,274 ton/year. Given that the production volume at same cement factory in 2005 was 627,000 ton/year (Cement Factory 2005 Annual Report: Sindicato Nacional da Industria do Cimento 2005), it can be deduced the ratio of waste treatment was no more than 0.84% of their production volume. In Japan, the ratio of waste treatment to production volume is 43.5%. In the State of Amazonas, the disposal amount using co-processing where no residues are generated at the cement factory is greatly limited.

Co-processing at a cement factory is a desirable form of final destination from an environmental conservation perspective. For IPAAM to make a breakthrough concerning the non-licensed landfill problem, it must collaborate with SUFRAMA to promote co-processing.

c. Poor Business Environment for Industrial Waste Disposal

As shown in Table 4-31: Categorization of Waste Services of 67 Companies with Environmental Licenses, putting aside the quality of services on offer, the structure for receiving wastes discharged from factories is sufficient, apart from final disposal. With 440 factories operating in PIM, comparatively, the number is more than enough. However, based on observations during the survey of waste service companies, it is hard to say the quality of service is ample. In particular, there were a number of problems observed concerning pollution control devices such as countermeasures for incinerator gas emissions. Namely, the conditions observed are not conducive to attracting investment for waste service companies to conduct sound waste treatment and disposal practices. The reason for this is that the environment, as pointed out below, is not suitable for industrial waste disposal business to conduct treatment appropriately.

- A large amount of industrial waste is being disposed of in the Manaus City landfill which does not collect a disposal fee.
- There are a large number of waste service companies that do not have an environmental license (i.e. unregistered entities) which are disposing waste for low fees.

- Administration does not have a clear picture of actual waste service company practices, including registered entities, so that regulation of unregistered and unsound entities is greatly confined.
- Under these conditions, competition between waste service companies is fierce, and disposal fees are extremely low. Thus, attracting investment for the construction and operation of appropriate treatment and disposal facilities is extremely limited.
- Also, some entities which discharge waste lack concern for whether the waste is disposed of properly.

In order for IPAAM to realize appropriate off-site treatment of factory waste, it must collaborate with SUFRAMA to facilitate a good business environment for industrial waste disposal.

4.4.3 Administration of IWM

As mentioned above, current conditions leave administration at risk, as it is responsible for the instruction, education and regulation of stakeholders concerning management at IW generation sources, and the monitoring and management of appropriate disposal of discharged waste. The primary issues are given below.

a. Organizational Structure

a.1 Legal System

In Brazil, the administration for industrial waste management in each State is under the jurisdiction of the State environmental authority. In Amazonas State, this is IPAAM, the Institute of Amazonas Environmental Protection. The legal system for administration of IWM, according to Federal law, follows State laws.

The Federal legal system serving the nation is quite elaborate and the National Solid Waste Policy (NSWP) was approved by the House of Commons (Camara de Deputados) Representatives on 10 March 2010 and covers all the principles, objectives, tools, guidelines, goals and actions adopted by the federal government, either alone or in cooperation with States, Federal District, Municipalities and private, with a view to integrated and environmentally sound management of solid waste. Also, the Amazonas State government primarily follows the Federal legal system and prepares the necessary State laws, so the required legal system to carry out IWM is prepared. The problem is development of the tools and the organizational structure needed to enforce the law.

a.2 Organizational Structure

At the national level, the organizational structure responsible for IWM has been duly developed. At the same time, strengthening is needed for the organizational structure at the State level which is responsible for actual administration of industrial waste management according to the law. In particular, there are shortfalls in the number of staff concerning industrial waste management.

In the State of Amazonas, the office responsible for IWM administration is the Environmental Monitoring Management Section (GMAM) of IPAAM. Although the office has a staff of seven, the work in which they are engaging is not IWM, but such work as the management of environmental licenses.

Also, as of December 2009, there is neither a unit nor in-house staff in charge of IWM at SUFRAMA, which manages the Industrial Pole of Manaus (PIM).[1]

b. Improvement and Upgrading of Management Tools

It is necessary for the administration to use a variety of tools in order to enforce sound waste management. Based on the current situation, improvement and upgrading the following tools will be vital.

- Improvement of the database for factories, which are the generation source of IW
- Improvement of the database of waste inventories which show the amount and composition of IW generated at factories as well as management conditions
- Improvement of the waste manifest system in order to track and monitor where and how IW discharged from factories is being disposed.
- Development of a database to register and manage industrial waste service companies

b.1 Improvement of Factory Database

SUFRAMA has developed a factory database for those that have entered PIM in order to award various amenities as appropriate, and is updating this database as needed. Nevertheless, a number of problems were identified, as follows, in this study when conducting the surveys on medical institutions and construction waste.

Of the factories on the SUFRAMA Factory List[2], 18 of the 475 in operation are located outside of the MFZ, the target area of the study. Consequently, the study confirmed whether any of the 457 factories located in PIM within the MFZ had medical facilities (i.e. clinics) or, in the past year, had had any construction works. The results are as follows.

- Factories which responded by telephone: 334
- Factory closures: 17
- Factories which declined to answer: 25
- Factories which could not be contacted by telephone: 81

Including the factories that could not be contacted by telephone (which assumes that some of these incidences were on account of number changes), the study reported that 440 PIM factories are operating in the MFZ area, excluding the 17 which had closed.

As shown above, the SUFRAMA factory database had not been updated to reflect the 17 factory closures. Furthermore, it is possible that the data was insufficient for the 81 factories that were not reachable by telephone.

The most important data for management of the industrial area (PIM) is that on which factories are operating, so it is necessary to keep that data as up-to-date as possible.

b.2 Improvement of Waste Inventory Database

Waste inventories are a critically important tool to understand the actual conditions of industrial waste management and formulate a plan for IW management. However, the following problems were identified concerning the waste inventories.

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[1] At present in December 2009, an industrial waste management unit has not officially been launched. It is planned for 2010 and 3 staff members will be assigned.

[2] Profile of the Companies with Projects Approved by SUFRAMA, December 2008 (Perfil Das Empresas Com Projetos Aprovados Pela SUFRAMA Dez/2008)

- Although all PIM factories are obligated to submit a waste inventory, the number of factories doing so stands at approximately one-forth.
- IPAAM does not have a database to manage and analyze waste inventories which are submitted.
- SUFRAMA is entering the submitted waste inventories into a database and calculating the generation amount. However, there is no recognition of which industrial wastes generated are disposed of on-site and which are discharged off-site for disposal, or how they are disposed. It is likely that the major cause for this is the complicated forms designated in CONAMA Resolution 313 and conflicting reporting methods (e.g. waste type, disposal method, units, etc) used by those reporting.

In order to resolve the above issues, it is necessary for IPAAM and SUFRAMA to improve the database of waste inventories as detailed below.

- The first step is to establish an easily understandable reporting format (waste type, disposal method, units, etc) based on the factory survey undertaken in this study, by refining the submittal of waste inventories into one unified method.
- Forthrightly prepare a system in which the submitted waste inventories are promptly entered into the database.
- At the same time, instruct and train all PIM factories on the unified reporting method and direct all factories to submit a waste inventory.

b.3 Improvement of Waste Manifest System

The waste manifest system is an indispensable administration tool used to monitor waste treatment and disposal after factory discharge. In the State of Amazonas, the creation and submittal of waste manifest documents is mandatory. However, IPAAM has not designated a specific waste manifest format that should be used. Thus, it is not possible to clarify the final destination of all wastes which are discharged. Improvement of the waste manifest system is a pressing issue for IPAAM, and it will be necessary to take the following steps.

- Create a uniform waste manifest format to be used, taking into consideration examples from States further along in development, such as Rio de Janeiro.
- On that basis, collaborate with those States to put the waste manifests on-line.
- Concurrently, arrange the data garnered from the waste manifest system into a database.

b.4 Development of Registry and Management Database for WSCs

In the State of Amazonas, waste service companies (WSC) are registered and managed using the environmental licensing system. However, the current system has a number of problems, and it is not possible to gauge the actual number of operators engaged in waste services. Also, there are some entities operating which are not yet registered, but it is not possible to expose those unsound operators. In order to improve this situation, it is necessary to forthrightly develop a database to register and manage industrial waste service companies as follows.

- Arrange the environmental licenses currently related to various waste services into one large category for waste-related services.
- Additionally, sub-divide waste-related service licenses into categories: collection and transportation, intermediate treatment, reuse/recycle, and final disposal.

- On that basis, require the waste service companies currently dispersed over a variety of activities to apply to acquire the new operation license.

b.5 Improvement of Data Management System

Simply constructing a database will not bring about its essential function. It is also necessary to continuously maintain the database, and work to expand and develop the management system. In particular, with the database at IPAAM serving as the seat for waste management, the following improvements will need to be made.

- Promptly develop a system in which it is possible to interface with the data contained in other organizations' databases.
- Provide the necessary personnel to manage the database and keep the data up-to-date.
- Consolidate a process in which the data can be shared, such as creating waste codes.

c. Strengthening Regulation

As mentioned above, the current organizational structure and management tools are not sufficiently developed, and thus regulations against illegal dumping, non-registered operators, improper treatment and disposal and such fall short. In the State of Amazonas, it is assumed that private-sector vitality will serve to bring about the facilities necessary for the appropriate treatment and disposal of industrial waste. As this will take a considerable investment from the private sector to construct treatment and disposal facilities, it is important that those investors can gauge recovery on their investment. The most important factor in doing so is to step up control of illegalities such as non-registered operators and illegal dumping as well as unsound treatment and disposal routes and eliminate them. Along with development of management tools and organizational structure, it is necessary to strengthen the structure of regulation implementation.

d. Pending Need for Cooperative Framework for Administration, Dischargers and Waste Service Companies

d.1 Cooperation between Administrative Entities

Although administration of industrial waste management in the State of Amazonas is led by IPAAM, a variety of administrative entities are involved. Therefore, IPAAM will need to cooperate with these other entities in order for them to establish an appropriate system for industrial waste management. For SUFRAMA, which manages PIM, collaboration with related organizations, starting with IPAAM, is necessary if PIM is to acquire an environmental license as requested by the State Public Ministry.

In particular, because the landfill in the State of Amazonas serving as the final destination for industrial waste for much of the waste disposed does not possess an environmental license, much of the waste is not being disposed of properly in the strictest sense. Furthermore, a large part of industrial waste final disposal is dependent on the city landfill run by the Manaus Municipal government. In order to make a breakthrough in this area, it is desirable that the related organizations, such as IPAAM (managing waste service companies), SUFRAMA (managing factories), Manaus City (managing the landfill), State Public Ministry (exposing unsound disposal), and FIEAM (the State industrial federation), establish a close, collaborative relationship.

d.2 Cooperation between Administration and Dischargers of Waste

Despite the obligation of all PIM factories to submit a waste inventory, the rate of submittal stands at one-forth. The cause is the factories' poor awareness of compliance, but also a lack of promotional activities to train and instruct factories on the administration's part. It is essential to form a collaborative structure between administration and the dischargers of waste if one hopes to expand the submittal rate of waste inventories and ensure that an improved waste manifest system functions. In order to develop a cooperative structure, the administrative parties should proactively carry out the following efforts on behalf of the factories which discharge waste.

- In order to facilitate the 3Rs and sound treatment on-site, encourage factories to form industrial waste measures such as a system of comprehensive responsibility and technology management system. To do so, administration should take up instruction and training of such personnel and be proactive in the provision of information about front-runners amongst factories regarding the 3Rs and sound treatment and disposal.
- Provide instruction and training on the method to create a waste inventory and waste manifest.
- Provide information on waste service companies that have acquired an environmental license to facilitate sound off-site treatment and disposal.

d.3 Cooperation between Administration and WSCs

During the survey of waste service companies (WSCs) as part of this study, 18 of the 53 companies which hold environmental licenses declined to cooperate with the study, despite encouragement by IPAAM. The reason may lie in a lack of awareness among the WSCs, but also points to the tenuous nature of the relationship between administration and WSCs. Also, with the existence of non-registered entities, licensed operators may harbor a sense of distrust regarding the poor business environment. In order make a newly developed registration system for WSCs function and expunge the existence of non-registered entities, it is essential for administration to form a collaborative relationship with licensed companies. To do so, the following efforts should be sought proactively at the behest of the administration on behalf of registered companies.

- Actively publicize a new WSC registration system to waste service companies. On this basis, provide instruction and training on how to prepare the application form for registration.
- Support the establishment of a technical management system amongst waste service companies in order to facilitate reuse/recycle and sound treatment and disposal. To do so, the administrative parties should provide opportunities for instruction and training of such personnel and actively promulgate information concerning reuse/recycle and sound treatment and disposal.
- Develop a database to register and manage WSCs forthrightly and consolidate efforts to regulate non-registered entities. Furthermore, publicize information on WSCs which hold environmental licenses to the factories, their clients. Through these activities, the business environment of WSCs will improve.

d.4 Cooperation between 3 Entities: Administration, Dischargers and WSCs

In order to establish a system of sound industrial waste management, it is essential that a collaborative relationship is formed between the three entities of factories, which discharge waste; waste service companies, which properly manage the waste discharged; and administration which monitors, guides, instructs, manages and regulates the previous two. At present, one would be hard-pressed to say that this collaborative structure is satisfactory. Thus, the related parties must make the above-mentioned improvements.

Moreover, in order to further develop the collaborative structure as mentioned above, it is important that administration, dischargers and WSCs create a place where they are able to exchange opinions and information, etc.

5. Master Plan on Industrial Waste Management

5 Master Plan on Industrial Waste Management

5.1 Future Socio-Economic Framework

5.1.1 Population

IBGE (Brazilian Institute of Geography and Statistics) conducted a long-term population projection between 1980 and 2050 and revised the projected results periodically. Here, the latest revised population projection of IBGE in 2004 is applied for projection of the population in the city of Manaus. According to the latest population data in IBGE, the population in Manaus is 1,738,641 in 2009. Based on this latest population data, the future growth of population in Manaus is projected as follows:

Table 5-1: Population Projection in Manaus (2009-2030)

Unit: thousand

Year	2009	2010	2015	2020	2025	2030
Population (Brazil)	194,370	196,834	208,468	219,078	228,874	237,738
Population (Manaus)	1,739	1,761	1,865	1,960	2,047	2,127

Source: IBGE (Brazilian Institute of Geography and Statistics)

The average annual population growth in the city of Manaus is estimated as 1.09% per year between 2009 and 2020 while it is 0.96% per year between 2009 and 2030.

5.1.2 Economy

According to the latest economic outlook available in the Central Bank of Brazil, the recent trend of GDP growth of Brazil and Manaus is as shown in the table below.

Table 5-2: Recent GDP growth in Brazil and Manaus

Year	2003	2004	2005	2006	2007	2008
Brazil GDP (billion Real)	2,376	2,512	2,591	2,694	2,858	3,005
Real Growth Rate (%)	1.1	5.7	3.2	4.0	6.1	5.1
Manaus GRDP (billion Real)	28.85	32.96	33.30	36.29	NA	NA
Real Growth Rate (%)	NA	14.2	1.0	9.0	NA	NA

Source: The Central Bank of Brazil

According to the announcement of the Finance Minister of Brazil, the real growth rate of GDP in Brazil is estimated as 1.22% in 2009 while it is expected to increase up to 5.8% in 2010. Based on the past trend of economic growth in Brazil, the study estimated the future economic growth with linear regressions model up until the year 2030. The result of estimation is shown in the next table.

Table 5-3: Estimated Economic Growth of Brazil

Year	2008	2010	2015	2020	2025	2030
Brazil GDP (billion Real)	3,005	3,218	3,794	4,386	4,978	5,570
Growth Rate (%/year)	-	3.5	3.3	2.9	2.6	2.3

Source: the Finance Minister of Brazil

On the other hand, the regional GDP of Manaus is only available between 2004 and 2006, by applying the linear regression model, the future economic growth of Manaus is estimated as shown in the table below.

Table 5-4: Estimated Economic Growth of Manaus

Year	2006	2010	2015	2020	2025	2030
Manaus GRDP (billion Real)	36.29	44.17	52.50	60.82	69.15	77.47
Growth Rate (%/year)	-	5.0	3.5	3.0	2.6	2.3

Source: the Finance Minister of Brazil

5.1.3 Estimation of the Future Industrial Growth

As for the source of data for the estimation of the future industrial growth, "Trend in Industrial Production Value by Type of Industry during 2004-2008, SUFRAMA" was used.

a. Source of Data Used

The following baseline data were calculated to estimate the framework of future industry growth of the Manaus Free Trade Zone.

1. Trend in Industrial Output by Type of Industry
2. Trend in Production Value by Type of Industry
3. Number of Employees by Type of Industry

The industrial output data (first item above) contains the trends of only a very limited set of products; with not enough data available to represent the entire SUFRAMA area, it was eliminated from the baseline data.

On the other hand, the production values (second item above) contain the industrial classifications for major sectors from 2004 to 2008, which is approximate to the classification used for the factory survey in this study and thus effective baseline data when used to establish the framework of future industry growth.

The third item above, concerning number of employees, contains detailed data beyond the sector-based employee data used in the factory survey. However, trends over time are not categorized by sector but only changes in the total number of employees in the SUFRAMA region.

Based on these factors, the study chose to apply the production value data by industrial sector in the SUFRAMA region, 2004 ~ 2008, to predict the framework of future industry growth.

b. Application of Production Value Data by Type of Industry

There is an inherent correlation between the industrial output in each sector and the amount of industrial waste generated. In turn, this underlines another correlation between industrial output and production value. However, to calculate production value using the unit generation amount (ton/real) requires taking into account trends in commodity prices and exchange rates. Therefore, estimating future industrial growth is done, first, by converting the current value, which is given in the data provided by SUFRAMA in Dollars, and obtaining the Brazilian currency value (Real) by using the yearly average exchange rate for each year. Then, discounting the inflation rate based on the 2004 consumer price index, and calculating the yearly production value for each type of industry. (Supporting Report: referencing the estimated value of production by type of industry, the 2004~2008 data is based on current data converted to 2004 real price value of production.)

c. Estimation of the Future Industrial Growth (2008-2030)

The framework of future industry growth is the basis of estimating the future industrial waste generation in PIM. The amount of industrial waste generation has the strongest correlation to industrial production although it is not linear considering the improvement of productivity in respective industries.

To estimate the future industrial growth in PIM, the study utilizes the data of industrial output by types of industry during 2004-2008 available in SUFRAMA, as shown in the table below.

Table 5-5: Trend of Industrial Production Value during 2004-2008

Unit: million $US

Factory Code	Sector	2004	2005	2006	2007	2008
F01	Beverage	152	163	210	84	100
F16	Garment & Footwear	5	12	17	12	21
F03	Printing	35	32	34	36	39
F04	Electrical/Electronics	4,967	6,748	7,840	8,029	8,993
F05	Lumber	21	23	21	25	23
F06	Machinery (Mechanical)	333	475	524	654	788
F07	Metals	393	678	1,068	1,505	2,090
F08	Non-Ferrous Metals	35	51	68	94	151
F09	Furniture	10	15	18	20	27
F10	Paper & Packaging	87	132	158	172	188
F11	Rubber	1.4	1.0	0.5	0.2	1.7
F12	Food Product	59	65	69	52	63
F13	Chemical	1,253	1,584	2,016	2,640	2,987
F14	Plastics	729	1,101	1,279	1,422	1,669
F15	Textiles	5	6	7	7	8
F17	Transportation Equipment	2,353	3,153	4,185	5,948	7,668
F19	Others	3,752	4,676	5,236	4,995	5,359
Total		14,190	18,915	22,750	25,695	30,176

Source: SUFRAMA

With the past industrial output data above, the future industrial growth in Manaus Free Zone is estimated in accordance with the following steps:

STEP 1: Conversion of the industrial output into real output value at 2004 price in Real

The industrial output value during 2004-2008 is converted into real output value at 2004 price in Brazilian Real using deflators and the average currency exchange rate in respective years, as shown in the table below.

Table 5-6: Trend of Industrial Output Value during 2004-2008 at 2004 Price

Unit: million Real

Factory Code	Sector	2004	2005	2006	2007	2008
F01	Beverage	445	370	429	160	178
F16	Garment & Footwear	15	27	35	22	38
F03	Printing	104	72	70	68	70
F04	Electrical/Electronics	14,536	15,270	15,988	15,213	15,974
F05	Lumber	62	53	44	47	41
F06	Machinery (Mechanical)	976	1,075	1,069	1,240	1,399
F07	Metals	1,150	1,535	2,177	2,851	3,712
F08	Non-Ferrous Metals	103	116	139	178	269
F09	Furniture	31	34	37	38	48
F10	Paper & Packaging	255	299	322	327	333
F11	Rubber	4.0	2.3	1.0	0.4	3.0
F12	Food Product	172	146	141	98	111
F13	Chemical	3,667	3,584	4,111	5,001	5,305
F14	Plastics	2,134	2,492	2,607	2,695	3,138
F15	Textiles	15	13	14	13	14
F17	Transportation Equipment	6,886	7,135	8,534	11,270	13,620
F19	Others	10,972	10,578	10,675	9,465	9,347
Total		41,527	42,801	46,393	48,686	53,600

Source: SUFRAMA

STEP 2: Estimation of the future industrial growth by approximate function analysis for each type of industries

Based on the approximate function analysis of the past trend of industrial growth for each type of industries, the study estimated the future industrial growth as shown in the table below up until the year 2030.

Table 5-7: Estimation of the Future Industrial Growth (2008-2030)

Unit: million Real

Factory Code	Sector	2008	2010	2015	2020	2025	2030
F01	Beverage	178	157	113	91	78	69
F16	Garment & Footwear	38	44	65	86	106	127
F03	Printing	70	59	52	48	45	43
F04	Electrical/Electronics	15,974	16,524	17,934	19,344	20,754	22,164
F05	Lumber	41	38	34	31	29	28
F06	Machinery (Mechanical)	1,399	1,556	2,062	2,568	3,074	3,580

F07	Metals	3,712	4,860	8,079	11,299	14,518	17,738
F08	Non-Ferrous Metals	269	318	515	712	908	1,105
F09	Furniture	48	53	72	92	111	131
F10	Paper & Packaging	333	381	473	565	658	750
F11	Rubber	3.0	0.8	0.5	0.4	0.3	0.3
F12	Food Product	111	96	81	73	67	63
F13	Chemical	5,305	6,211	8,558	10,905	13,251	15,598
F14	Plastics	3,138	3,325	4,257	5,190	6,123	7,055
F15	Textiles	14	13	11	10	8	6
F17	Transportation Equipment	13,620	16,531	25,334	34,136	42,939	51,742
F19	Others	9,347	8,636	6,625	4,612	2,603	590
Total		53,600	58,803	74,265	89,762	105,272	120,789

Source: SUFRAMA

The estimation above is based on a 'Business-as-Usual' scenario, assuming that past trends revealed by statistical analysis will be reflected in future industrial growth. If SUFRAMA has some plans on future industrial location and/or development of Manaus Free Zone, it should be reflected to improve this estimation.

5.2 Projection of Future IW Generation

5.2.1 Scope of Projection

a. Target Industry Types

In this report, the following 19 industry classifications used by SUFRAMA for PIM factories were used as the targets for the future estimate of IW generation[1]

Table 5-8: SUFRAMA's Factory Classification

Factory Code	Description of subsector
F01	Beverage (soft drink, alcoholic) and vinegars
F02	Leathers, skins and similar
F03	Printing and graphical company
F04	Electric, electronic and communication materials
	4.1 Components
	4.2 Products (except copy machines)
	4.3 Copy machines and similes
F05	Wood
F06	Mechanical
	6.1 Watch
	6.2 Other mechanical industries
F07	Metallurgy
F08	Non metallic minerals
F09	Furniture
F10	Paper, cardboard, cellulose

[1] Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA (CGPRI & CGMER/COCAD SUFRAMA , up to 8/2008)

F11	Rubber
F12	Food products
F13	Chemical
F14	Plastic material products
F15	Textile
F16	Clothing, fabric and travel goods
F17	Transport material
	17.1 Two wheel
	17.2 Naval
	17.3 Other transport material industry
F18	Construction
F19	Others
	19.1 Optical
	19.2 Toys
	19.3 Devices, equipment, and fotogr. accessories
	19.4 Pens and disposable razors
	19.5 Other several industries

b. Targeted Industrial Waste

The industrial wastes targeted for generation estimates are those required by CONAMA Resolution 313 to be included in a waste inventory. For this report, the following three main categories were used to estimate generation amount.

- General Industrial Waste
- Health-care Waste
- Construction Waste

c. Estimation Period for Generation Amount

The estimation period for the generation amount will be until the Master Plan target year 2015.

5.2.2 Methodology of Estimating Future IW Generation

a. Formula used to Estimate the Generation Amount

Estimation of future IW generation amount was made based on the following equation.

$$IWG = \sum_{i=1}^{n}\sum_{j=1}^{m}(Mi \cdot Gij)$$

Basically, the future IW generation amount is calculated using **the generation rate (G)** from each generation source, multiplied by **the number of basic units (M)** from each generation source. The number of basic units (M) can be the production amount, production value, etcetera, but in this study, number of employees was used for reasons given below.

The following table shows how each item of the above formula was established in terms of the previously mentioned 3 types of industrial waste.

Table 5-9: Explanation of Items of Estimation Formula for Future IW Generation Amount

Formula Items	General IW	Health-care Waste	Construction Waste
IWG	Generation Amount of General IW (ton/year)	Generation Amount of Health-care Waste (ton/year)	Generation Amount of Construction Waste (ton/year)
i	Factory type	Only one generation rate (GR) is used for all PIM factory	Only one generation rate (GR) is used for all PIM factory
j	Type of general IW	Type of health-care waste	Type of construction waste
M	Number of employees	Number of employees	Number of employees
G	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)
n	Factory type number (19 types)	Factory type number (only one type)	Factory type number (only one type)
m	Waste type number (29 types)	Waste type number (5 types)	Waste type number (4 types)

b. Setting the Waste Generation Rate (GR)

The waste generation rate (GR) is given for each type of waste for all three types of industrial waste[1]. The GR used is ton per year per person (ton/year/person). The GR was established based on data that the study team gathered when carrying out three surveys: factories, medical institutions, and construction waste. Here, to estimate waste generation amount, it is assumed that until 2015 there is no change in the GR. The table below shows the industry type and generation amount of each type for general industrial waste.

b.1 General Industrial Waste

The tables below show the industry type and generation rate (GR) of each type for general industrial waste. However, Table 5-10 shows the Non-Hazardous and Hazardous industrial waste (Non-HIW and HIW, respectively) according to Non-Production and Production Process in each industry type, whereas Table 5-11 shows the waste generated from Non-Production and Production Process according to Non-HIW and HIW in each industry type. Namely, this is a selection of the generation rates found in the study; the GR of 29 waste types were calculated for each of the 19 types of industry, but the detailed results are given in the Data Book.

Table 5-10: Generation Rate for General Industrial Waste by Industry Type

Unit : kg/person/year

Factory Code	Non-Production Process		Production Process	
	Non-HIW	HIW	Non-HIW	HIW
F01	1,349.6	19.0	111.8	21.1
F02[*1]	---	---	---	---
F03	84.2	6.4	1,686.2	899.1
F04		86.7	910.8	195.5
F05[*2]				

1 Given for 19 factory types for general IW.

F06	557.2	228.3	1,699.5	242.9
F07	745.0	141.3	2,979.8	207.5
F08	184.1	1.7	841.4	3.1
F09			72.1	245.2
F10	11,481.4	69.9	5,006.7	448.2
F11*2				
F12	0.4		14,125.3	241.1
F13	133.1	0.9	1,089.2	100.0
F14	291.1	781.3	465.0	71.5
F15*2				
F16*2				
F17	137.3	13.8	471.4	363.6
F18*2				
F19	250.7	0.8	692.3	218.6
All Category	439.4	112.0	885.8	262.4

Note : *1 : No factory corresponded to category F02 on the SUFRAMA factory list.
*2 : Listed on the SURAMA factory list and requested for the factory survey, but none of factory of this category was surveyed in this study.

Table 5-11: Generation Rate of General Industrial Waste by Waste Type

Unit : kg/person/year

Waste Code	Non- HIW		Waste Category	HIW	
	Non Process	Process		Non Process	Process
NH01	66.9	1.5	HW01	0.0	0.8
NH02	45.9	42.9	HW02	---*1	---*1
NH03	89.6	241.3	HW03	0.0	0.1
NH04	22.0	136.7	HW04	0.0	9.1
NH05	3.0	0.4	HW05	0.0	0.6
NH06	0.3	0.0	HW06	---*1	---*1
NH07	0.0	0.5	HW07	0.7	56.4
NH08	---*1	1.9	HW08	---*1	3.0
NH09	82.7	360.2	HW09	33.2	30.2
NH10	24.7	16.5	HW10	0.0	0.0
NH11	1.7	4.9	HW11	51.9	8.4
NH12	4.6	0.1	HW12	---*1	0.8
NH13	98.0	78.9	HW13	2.7	0.4
All Category	439.4	885.8	HW14	1.8	115.2
			HW15	14.5	26.5
			HW16	7.2	10.9
			All Category	112.0	262.4

Note : *1: Indicates that corresponding waste was not generated.

b.2 Health-care Waste

The generation amount of each group of health-care waste is given in the table below.

Table 5-12: Generation Rate of Health-care Waste

Waste Category			Clinics		General Hospital
			kg/clinic/day	g/employee/day*1	kg/hospital/day
Group A	A1	Biologic	0.16	0.22	6.01
	A2	Animals	0.00	0.00	0.00
	A3	Body part	0.10	0.14	8.11
	A4	Patient care etc.	0.26	0.36	8.64
	A5	Prions	---	---	---
Group B		Chemical etc.	0.27	0.38	1.7
Group C		Radioactive waste	0.00	0.00	0.0
Group E		Piercing or Cutting	0.44	0.62	3.4
Group D		Common waste	1.17	1.64	94.0
Total			2.40	3.36	121.8

Note *1: In 2009, there were 116,192 employees.

b.3 Construction Waste

The generation rate was calculated for each class of construction waste, as listed in CONAMA Resolution 307.

Table 5-13: Generation Rate of CONAMA Resolution 307 Construction Wastes

Class	Class A	Class B	Class C	Class D	Total
Generation unit (kg/factory/day)	227.14	1.04	0.00	0.00	228.18

In the survey, the 4 classes of waste as shown in CONAMA Resolution 307 were subdivided into 44 types. The generation rates for those 44 types which were reported are given below. For those waste codes not listed indicates that generation of such waste was not reported.

Table 5-14: Generation Rate of Construction Waste

Waste No.	Name of Waste	kg/factory/day
01	Excavated soil	9.04
02	Concrete debris	14.75
03	Asphalt debris	17.12
04	Brick debris	0.83
06	Tile and ceramic	0.003
11	Plastic/vinyl sheet	0.12
12	Iron-bar, steel materials	0.07
13	Small metal waste	0.16
17	Plaster boards	0.01
20	Wood debris	0.37
21	Timber form	0.06

22	Scaffolding material	0.34
23	Interior timber	0.32
24	Packing (cardboard)	0.26
29	Machine oil	0.02
33	Ash	0.05
44	Mixed construction waste	184.66
Total		228.18

c. Future estimation for number of employees

The future estimation of number of employees is an important variable when estimating the waste generation amount. The variable for number of employees was selected, particularly, for the following reasons.

1. It is estimated that “the increase in waste generated from factories tends to be closer in relation to growth in number of workers rather than growth in production.”
2. Manufacturers and other industries will increase production according to a rise in demand to expand their profits, but they attempt to control production costs per item as much as possible through improved productivity. These efforts include improving worker productivity, economizing energy use and resources (raw materials).
3. Economizing on energy and resources is, in due course, tied to the reduction of waste generated through production activities. Therefore, assuming such efforts are made, the future amount of waste generated is estimated as a factor in improved productivity included in "growth in number of employees" rather than output growth.

However, the only data available is that for the total number of employees in PIM overall, as the corresponding data for the categories in each of the 19 types of industry does not exist. Accordingly, analysis of the correlation between total number of employees in PIM, 2004 ~ 2008, and estimated industrial growth resulted in an average annual growth in overall PIM production value of 6.6%, thus confirming that average annual growth of direct employment in the same period will remain at 5%.

Based on these results, the forecast for employees in each type of industry was estimated using the following method.

1. The correlation between the change in number of employees in PIM (annual average of 5.0% growth, 2004 ～2008) and change in production value (annual average of 6.6% growth, 2004 ～2008) was estimated, showing that PIM labor productivity will improve 1.5% annually on average.
2. Based on the assumption above, using the 2009 data for number of employees in each of the 19 industry types, and 2009 ~ 2015 estimated industry growth for each industry type, the number of employees in each sector was estimated for 2015 using the following formula:

   Number of Employees (2015) = Number of Employees (2009) $\times$ {2015 industrial growth/(2009 industrial growth $\times 1.015^{6}$)}

3. Results were similarly sought for each of the 19 types of industry.

The forecast for number of employees was estimated using the above conditions with the results as shown in the following table.

Table 5-15: Estimated Forecast for Number of Employees

Factory Code	2009			2015		
	Industrial growth	Number of Employee	Unit Industrial growth	Industrial growth	Number of Employee	Unit Industrial growth
	(mil. Real)	(employee)	(mil. Real /employee)	(mil. Real)	(employee)	(mil. Rea l/employee)
F01	173	2,975	0.058	113	1,794	0.063
F02	---	---	---	---	---	---
F03	62	843	0.074	52	642	0.081
F04	16,242	37,765	0.430	17,934	38,157	0.470
F05	40	348	0.115	34	270	0.126
F06	1,455	5,464	0.266	2,062	7,086	0.291
F07	4,217	6,003	0.702	8,080	10,521	0.768
F08	279	698	0.400	515	1,178	0.437
F09	49	445	0.110	72	600	0.120
F10	363	1,789	0.203	473	2,131	0.222
F11	0.9	133	0.007	0.5	63	0.008
F12	101	538	0.188	81	393	0.206
F13	5,742	1,355	4.238	8,558	1,847	4.634
F14	3,138	9,625	0.326	4,257	11,958	0.356
F15	13	20	0.650	11	15	0.711
F16	40	589	0.068	65	878	0.074
F17	14,771	43,937	0.336	25,334	69,030	0.367
F18	9,355*1	440	21.261	6,623*1	285	23.248
F19		3,225	2.901		2,088	3.172
Total	56,041	116,192	0.482	74,265	148,936	0.527

*1: Statistically, the type of industrial growth for F18 and F19 are the same. Here, in order to calculate the unit industrial growth for each industry, the same industrial growth trends were used.

The value and rate of both total industrial growth and total number of employees were estimated, as shown in the following graph.

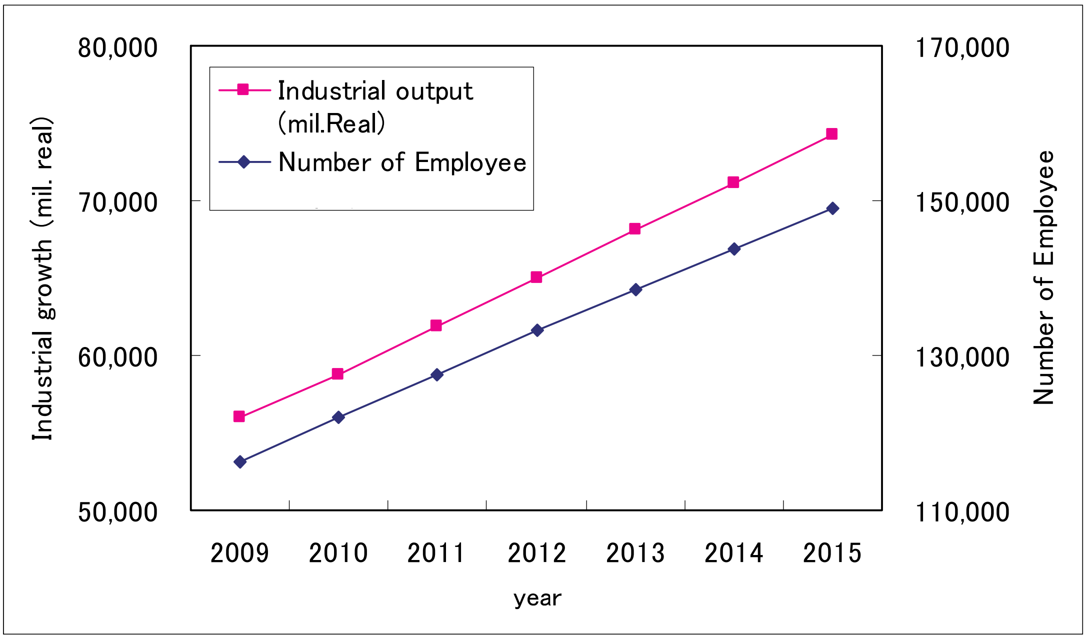


Figure 5-1: Estimated Results for Total Industrial Growth and Total Number of Employees (Forecast)

Figure 5-2: Estimated Results for Total Industrial Growth and Total Number of Employees (Rate)

5.2.3 Estimation of Future IW Generation Amount

Future IW generation rate is the product of the above-mentioned generation rate of industry/industrial waste by type (general IW, health-care waste, construction waste) and the number of employees by industry. The results are as follows.

a. General Industrial Waste Generation

The generation amount of general industrial waste in the entire target area of the study may be calculated by multiplying a GR of a general IW by the number of employees of each year. Below, Non-HIW and HIW generated from Non-Production and Production Processes was calculated for 2015.

The generation amount of general IW in 2009 was estimated at 591.5 ton/day. Further, the 2015 general industrial waste amount generated was estimated by multiplying each type of waste in each sector (Factory Category) by the future index 737.7 ton/day. It is estimated that in 2015 there will be about 1.3 times the present amount of general IW.

Table 5-16: Forecast Generation Amount of General IW by Factory Category (2015)

Factory Category		Non-Production		Production Process		All Process	
		Non-HIW	HIW	Non-HIW	HIW	2009	2015
F01	Beverages	6.6	0.1	0.5	0.1	12.2	7.3
F02	Leather	-	-	-	-	-	-
F03	Printing	0.1	-	3.0	1.6	6.2	4.7
F04	Electrical	51.3	9.1	95.2	20.4	174.1	176.0
F05	Lumber	0.3	0.1	0.7	0.2	1.7	1.3
F06	Machinery	10.8	4.4	33.0	4.7	40.9	52.9
F07	Metal	21.5	4.1	85.9	6.0	67.0	117.5
F08	Nonferrous Metal	0.6	-	2.7	-	2.0	3.3
F09	Furniture	0.7	0.2	0.1	0.4	1.0	1.4
F10	Paper	67.1	0.4	29.2	2.7	83.3	99.4
F11	Rubber	0.1	-	0.2	-	0.6	0.3
F12	Food	-	0.1	15.2	0.3	21.3	15.6
F13	Chemical	0.7	-	5.5	0.5	4.9	6.7
F14	Plastic	9.5	25.6	15.2	2.3	42.4	52.6
F15	Textiles	-	-	-	-	0.1	0.1
F16	Clothing	1.1	0.3	2.1	0.6	2.7	4.1
F17	Transportation	26.0	2.6	89.2	68.8	118.8	186.5
F18	Construction	0.3	0.1	0.7	0.2	2.1	1.3
F19	Other	1.4	-	4.0	1.3	10.2	6.7
Total		198.1	47.1	382.4	110.1	591.5	737.7

As shown in the table above, 93% of the total general IW will be generated in the following 6 factory's categories:

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
F04	Electrical industry	174.1	176.0	1.1
F17	Transport Machinery	118.8	186.6	57.0
F10	Paper industry	83.3	99.4	19.3
F07	Metal industry	67.0	117.5	75.3
F14	Plastic Industry	42.4	52.6	24.1
F06	Machinery	40.9	52.9	29.3
Total		526.5	685.0	30.1

Among the 6 large generation sources the highest increase rate is F07: Metal Industry, 75.3%, followed by F17: Transport Machinery, 57.0%.

The following two tables show forecast of generation amount of general Non-HIW and HIW in 2015, respectively:

Table 5-17: Forecast Generation Amount of General Non-HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
NH01	Kitchen waste (include waste from animal such as bone, skin, hair)	26.0	32.8
NH02	Wood	29.2	34.0
NH03	Paper	120.0	137.2
NH04	Plastic or polymers and resins	54.5	62.8
NH05	Textile and fiber	1.0	1.1
NH06	Animal oil, Vegetable oil	0.1	0.1
NH07	Rubbers and Leather	0.2	0.2
NH08	Ash/dust from coal-fired power plants, etc.	0.7	0.7
NH09	Metals and metal alloys such as aluminum, copper, bronze	163.6	218.0
NH10	Ceramic & Glasses	13.4	14.8
NH11	Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	1.7	2.6
NH12	Mixed waste (This code shall be applied in case wastes are discharged without separation.)	1.5	1.1
NH13	Others	59.9	75.1
Total		**471.8**	**580.5**

Table 5-18: Forecast Generation Amount of General HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
HW01	Inorganic acid	0.2	0.3
HW02	Organic acid	-	-
HW03	Alkalis	-	-
HW04	Toxic Compounds	2.8	3.6
HW05	Inorganic Compounds	0.2	0.3
HW06	Other Inorganic	-	-
HW07	Organic Compounds	18.9	22.5
HW08	Polymeric Materials	1.0	1.4
HW09	Fuel, Oil and Grease	20.0	27.0
HW10	Fine Chemicals and Biocides	-	-
HW11	Treatment Sludge	20.6	24.9
HW12	Ash from incinerator	0.2	0.3
HW13	Dust and Air pollution control (APC) products	1.0	1.8
HW14	Other Hazardous substance (besides HW01-HW13)	34.4	50.7
HW15	Mixed Waste	14.7	16.9
HW16	Hazardous materials from Non-production process	5.7	7.5
Total		**119.7**	**157.2**

As shown in the Table 5-17, 72% of the general Non-HIW will be main 3 types of waste, i.e. NH09: Metal Scrap, NH03: Waste Papers and NH04: Waste Plastics. Among the 3 main types of general Non-HIW the highest increase rate is NH09: Metal Scrap, 33.3%, followed by NH04: Waste Plastics, 15.2%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
NH09	Metal Scrap	163.6	218.0	33.3
NH03	Waste Papers	120.0	137.2	14.3
NH04	Waste Plastics	54.5	62.8	15.2
-	Other than the above 3 Types of Waste	133.7	162.5	21.5
	Total	471.8	580.5	23.1

As shown in the Table 5-18, 47.3% of the general HIW will be main 3 types of waste, i.e. HW09: Fuel, Oil and Grease, HW11: Treatment Sludge and HW07: Organic Compounds. Among the 3 main types of general HIW the highest increase rate is HW09: Fuel, Oil and Grease, 353%, followed by HW11: Treatment Sludge, 20.9%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
HW09	Fuel, Oil and Grease	20.0	27.0	35.0
HW11	Treatment Sludge	20.6	24.9	20.9
HW07	Organic Compounds	18.9	22.5	19.0
-	Other than the above 3 Types of Waste	60.2	82.8	37.5
	Total	119.7	157.2	31.3

b. Health-care Waste

The generation amount of health-care waste in the entire target study area is calculated by multiplying the generation rate per employee by the number of employees in each year. The results for each type of waste are shown below.

The generation amount of health-care waste in 2009 and 2015 is estimated at 391.2 kg/day and 500.5 kg/day, respectively. Health-care waste in 2015 will be generated at 1.3 times the current amount.

Table 5-19: Forecast Amount of Health-care Waste

Waste Category		Generation Rate	Generation amount	
		g/employee/day	2009	2015
			kg/day	kg/day
Group A	A.1	0.22	26.1	32.8
	A.2	0.00	0.0	0.0
	A.3	0.14	16.3	20.9
	A.4	0.36	42.4	53.6

	A.5	---	---	0.0
Group B		0.38	44.0	56.6
Group C		0.00	0.0	0.0
Group E		0.62	71.7	92.3
Group D		1.64	190.7	244.3
Total		3.36	391.2	500.5

c. Construction Waste

The amount of construction waste generated according to each class as shown in CONAMA Resolution 307 is calculated by multiplying the generation rate per employee for each waste by the number of employees each year. The results estimated for each type of waste are shown below.

The amount of construction waste generated in 2009 and 2015 is estimated at 36.96 ton/day and 47.54 ton/day, respectively. The amount of construction waste generated in 2015 is estimated to be about 1.3 times the current amount.

Table 5-20: Generation Amount of Construction Waste according to CONAMA Resolution 307

Class	Class A	Class B	Class C	Class D	Total
Construction Waste Generation in 2009	36.79	0.17	0.00	0.00	36.96
Construction Waste Generation in 2015	47.28	0.26	0.00	0.00	47.54

The study surveyed 44 types of waste according to the 4 classes as shown in CONAMA Resolution 307. The generation rate of these 44 types of wastes is shown below. For those waste codes not listed indicates that generation of such waste was not reported.

Table 5-21: Forecast Amount of Construction Waste

Waste No.	Name of Waste	Generation Rate	Generation amount	
			2009	2015
		kg/employee/day	ton/day	ton/day
01	Excavated soil	0.013	1.46	1.94
02	Concrete debris	0.021	2.39	3.13
03	Asphalt debris	0.024	2.77	3.57
04	Brick debris	0.001	0.13	0.15
06	Tile and ceramic	0.000	0.00	0.00
11	Plastic/vinyl sheet	0.000	0.02	0.02
12	Iron-bar, steel materials	0.000	0.01	0.01
13	Small metal waste	0.000	0.03	0.03
17	Plaster boards	0.000	0.00	0.00
20	Wood debris	0.001	0.06	0.16

21	Timber form	0.000	0.01	0.01
22	Scaffolding material	0.001	0.06	0.15
23	Interior timber	0.000	0.05	0.04
24	Packing (cardboard)	0.000	0.04	0.04
29	Machine oil	0.000	0.00	0.00
33	Ash	0.000	0.01	0.01
44	Mixed construction waste	0.257	29.92	38.28
Total		0.318	36.96	47.54

d. Total Amount of Industrial Waste Generated and IWM Stream in 2015

The following table shows the industrial waste generation amount for 2009 and 2015.

Table 5-22: The Industrial Waste Generation Amount for 2009 and 2015

unit : ton/day

Waste		2009	2015
GIW		591.5	737.7
	Non-GHIW	471.8	580.5
	GHIW	119.7	157.2
Health-care waste		0.4	0.5
Construction waste		37.0	47.5
Total		628.9	785.7

From the above results, it is estimated that the total generation amount for industrial waste in PIM in 2015 will be 785.7 ton/day.

If current IWM is continued in 2015, IWM flowchart will be shown in the following figure.

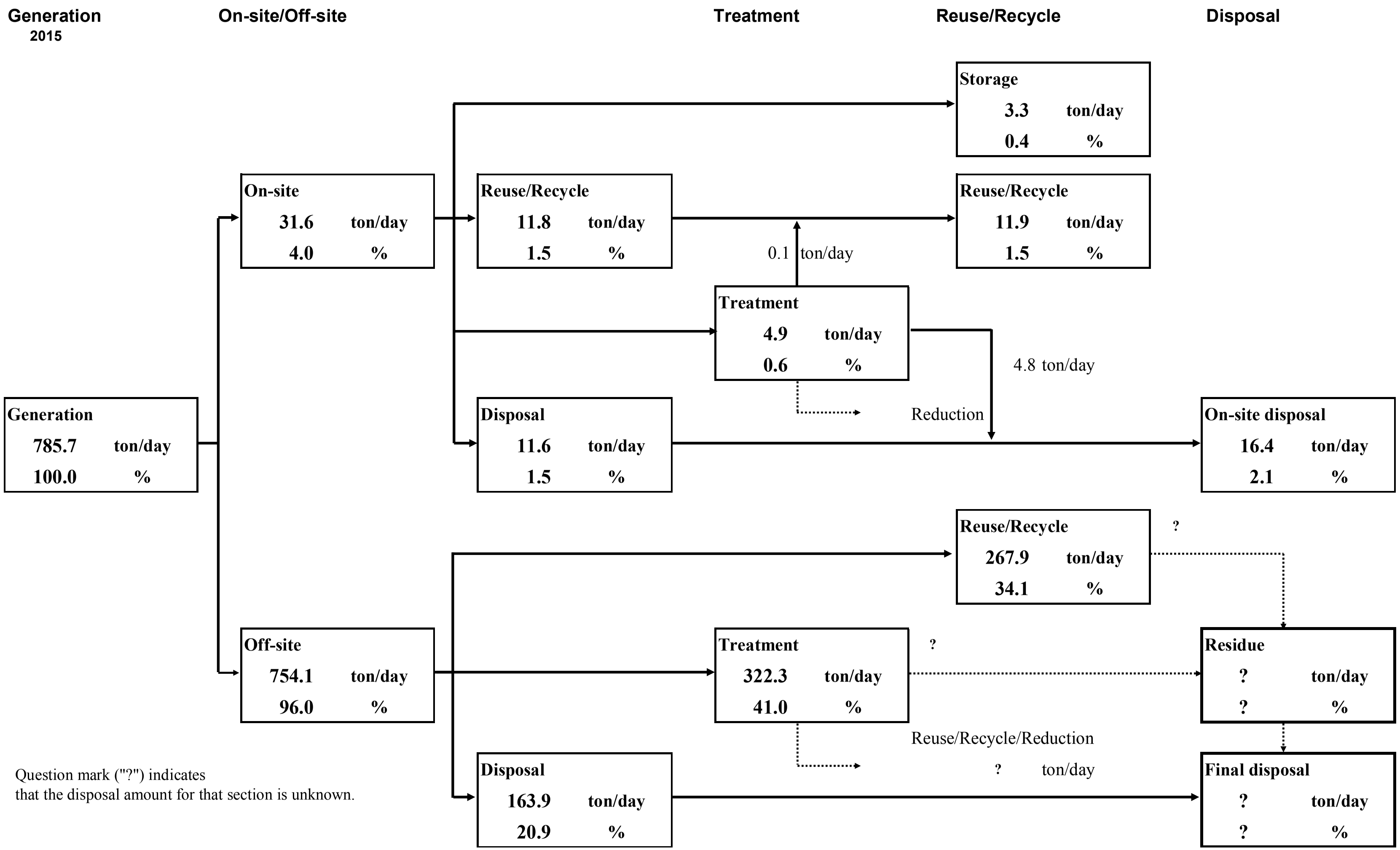


Figure 5-3: Industrial Waste Treatment and Disposal Stream in 2015

5.3 Background, Vision and Targets of M/P

5.3.1 Background of M/P

According to "Economic Instruments for the Amazon Protection, The Experience of Industrial Pole of Manaus", economic activity in PIM is a great contributor to the preservation of rainforest in the Amazonas State. As the table below shows, the rate of reduction in preserved forest area in Amazonas State from 2000-2005 was the lowest amongst all in the Amazon region. Further, the area of forest preserve in ratio to that of the entire state is second highest after the State of Amapá.

Table 5-23: Area of Forest Preserve in the Amazon Region

State	2000	2001	2002	2003	2004	2005	Reduction Rate
Amapá	98.8%	98.6%	98.5%	98.2%	98.1%	98.0%	0.8%
Amazonas	98.3%	98.2%	98.1%	98.0%	97.9%	97.9%	0.4%
Roraima	96.7%	96.1%	95.9%	95.6%	95.3%	95.2%	1.5%
Acre	90.3%	90.0%	89.4%	88.8%	88.2%	87.6%	2.7%
Pará	86.8%	84.6%	83.9%	82.9%	82.0%	81.3%	5.5%
Rondônia	70.6%	69.4%	68.0%	66.4%	64.1%	62.4%	8.2%
Mato Grosso	72.5%	71.2%	69.3%	67.3%	64.9%	63.3%	9.2%
Maranhão	54.9%	33.2%	32.1%	31.1%	29.8%	28.9%	26.0%
Tocantins	26.8%	26.1%	25.5%	25.1%	24.5%	23.5%	3.3%

(Source) Economic Instruments for the Amazon Protection, The Experience of Industrial Pole of Manaus

The same report also estimates that the amount of carbon credits in the seven years between 2000 and 2006 would be valued between 1 to 10 billion dollars.

As stated above, the measures by SUFRAMA to promote PIM have contributed greatly to forest preservation. Yet, the development of PIM has raised concern over environmental degradation due to illegal dumping of industrial waste, etc. The graph below illustrates the situation.

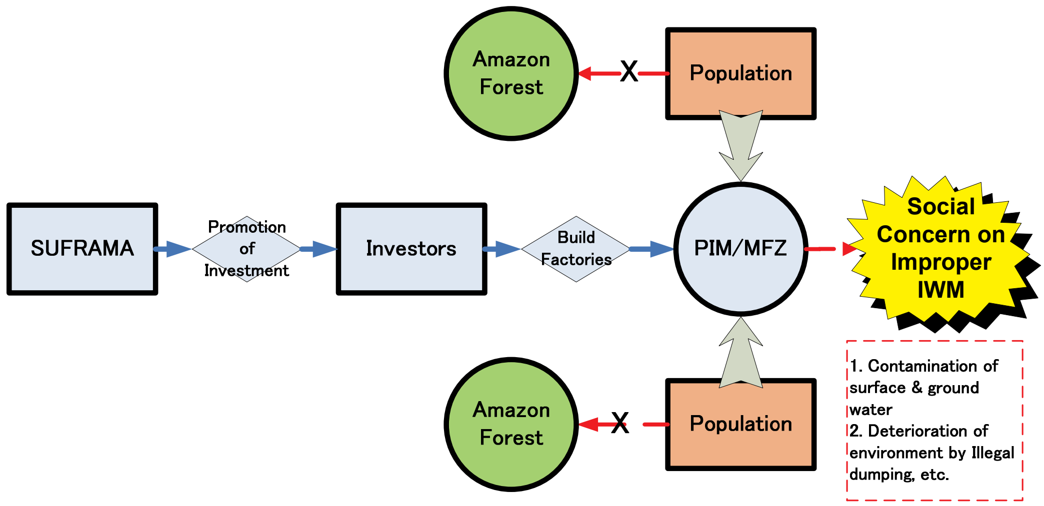


Figure 5-4: Relationship between PIM and Amazon Forest Preservation (Before M/P)

As the PIM developed, the Public Ministry of Amazonas State recognized the existence of environmental deterioration from illegal dumping of industrial wastes, etc. and, on December 21, 2001, called for SUFRAMA to obtain an environmental license for PIM. This caused SUFRAMA and IPAAM to join efforts in creating an environmental conservation plan for PIM, including proper management of industrial wastes, needed to obtain such a license.

SUFRAMA, as the counterpart of this study, will play the central roll in implementing the proposed M/P. As an organization, SUFRAMA is responsible for granting investment incentives with the aim of realizing socio-economic development by promoting commercial investment, starting with factories, agro-business and others, while also pursuing sustainable management practices to preserve the biodiversity widely found in the Occidental Amazon region.

Therefore, in addition to manufacturers, the M/P proposed in this study seeks to attract waste service companies that will play a role in environmental preservation and promote proper treatment of waste. The M/P was formulated keeping in mind the concept of further growth of PIM while continuing to promote the preservation of the State's natural environment. This principle is illustrated in the following figure.

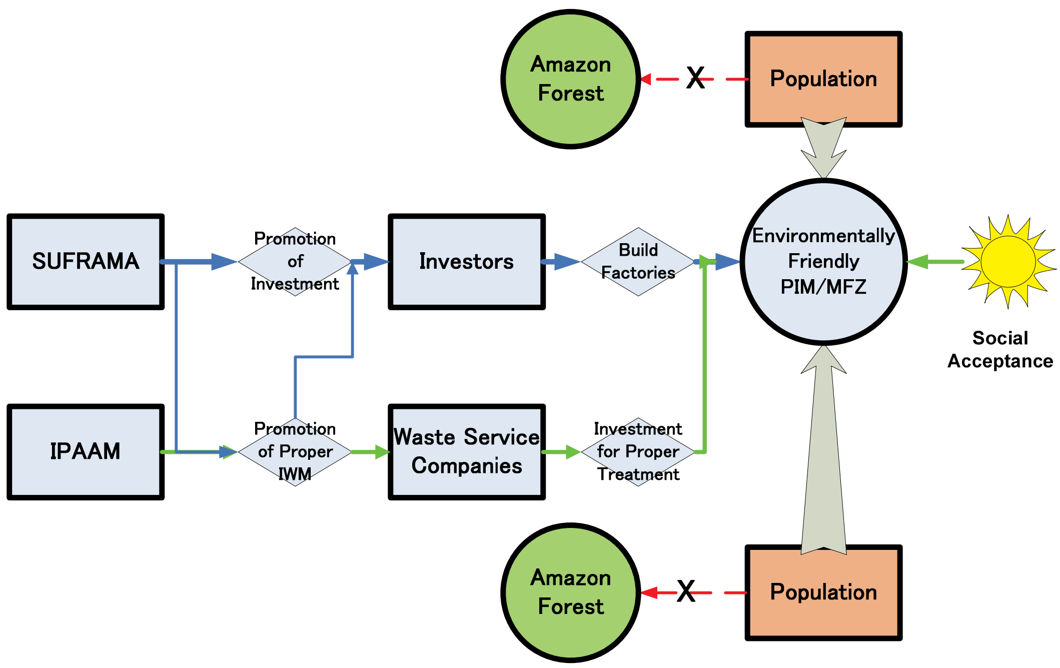


Figure 5-5: Relationship between PIM and Preservation of the Amazon Forest (After M/P)

5.3.2 Goal

The objective of the Master Plan (M/P) to be formulated in the study is to "Establish an appropriate industrial waste management system" by the target year 2015 for the study area, the Industrial Pole of Manaus (PIM).

Achieving this objective aims to meet the following overall objectives.

- That appropriate treatment and disposal of industrial waste and 3Rs (Reduce, Reuse, Recycle) will be implemented based on the industrial waste management master plan in the study target area.
- Through the appropriate treatment and disposal of industrial waste and implementation of the 3Rs, improper treatment and disposal of industrial waste will decrease and environmental impact will be reduced.

To realize the above conditions, companies both domestic and foreign will be encouraged to enter PIM and create new employment opportunities.

5.3.3 Issues to Overcome in order to Achieve Objectives

In order to achieve the M/P objectives, it will be necessary to solve the following issues related to the present system of industrial waste management.

a. Clarification of Industrial Waste Treatment and Disposal Practices

- Further information is needed from dischargers (factories) as well as waste service companies (WSCs) on the destination of residues after intermediate treatment, reuse and recycling. Without such information, it is not possible to clarify all aspects of industrial waste management in PIM (from generation to final disposal).
- The cause, despite the fact that IPAAM requires a waste manifest to be submitted in order to obtain an environmental license, is often a need for clear rules on the documents. Since the dischargers and the waste service companies each use and submit their own in-house forms, it is impossible for IPAAM to aggregate, analyze and manage the information contained in the manifests.
- Every PIM factory in the State of Amazonas must submit a waste inventory (WI). However, nearly 3/4 of factories do not submit WI.

b. Lack of a Landfill with Operation License

- The main final destination for industrial waste generated in PIM is, as of the end of 2009, two landfills; one owned by the municipality of Manaus and the other by a private company. However, neither is in possession of an operation license for the landfill. Since the landfills are the primary final destination for industrial waste generated in PIM, most factories in PIM are unable to satisfy the requirements to obtain ISO 14000.
- The construction and operation of a landfill which has obtained an operation license has been a long-time issue for PIM industrial waste management, but little progress has been made.
- In regards to final destination, co-processing treatments that do not produce a residue are extremely limited.[1]

[1] The sole cement factory, Itautinga, in the Manaus Free Zone treats 5,274 tons of waste per year (ref: WSC Survey). Using the factory's 2005 production output of 627,000 ton/year (Cement Factory Annual Report 2005: Sindicato Nacional da Industria do Cimento 2005), waste treatment (use of waste for cement production) is a mere 0.84% of production. In contrast, the percentage of waste treatment to cement production in Japan is 43.5%.

c. Weak Administration for the Industrial Waste Management System

- More staff is needed for industrial waste management since, as of December 2009, there are no staff at SUFRAMA dedicated to this work[1], and although there are 8 staff at IPAAM, they are responsible not only for industrial waste management but also for environmental licensing management.
- The waste service companies (WSC) registration management system is considered the environmental license system, which needs to be more fully developed.
- Administration is unable to expose non-registered or illegitimate companies so needs a clearer picture of actual conditions related to waste service companies.
- Waste inventories (WI) are submitted, but there is a need to strengthen abilities to analyze and manage them.

d. Poor Business Environment for Industrial Waste Treatment and Disposal

The business environment is very poor to conduct proper industrial waste treatment/disposal due to the following conditions:

- The landfill in Manaus City is used to dispose of a large amount of industrial waste but the disposal fee is currently "free".
- Many WSC which have not obtained an environmental license (non-registered) are disposing waste at extremely low cost.
- The administration is extremely limited in its regulation of non-registered companies and improper treatment and disposal.
- Conditions are such that competition between WSC is fierce and the disposal costs are extremely low. Thus, there are tremendous limits on investment for constructing and operating a proper treatment and disposal facility.

5.4 Master Plan

An industrial waste management master plan (M/P) has been put together to address how the industrial waste management issues presented in this chapter should be ameliorated.

5.4.1 Summary of Industrial Waste Management Master Plan

An approach and measures to resolve the above-mentioned 4 issues concerning industrial waste management are summarized in the figure below. Each approach and measure in the figure is then summarized in the table thereafter.

[1] As of December 2009, the industrial waste management unit has not been officially launched. There are plans to dispatch 3 staff to establish the unit in 2010.

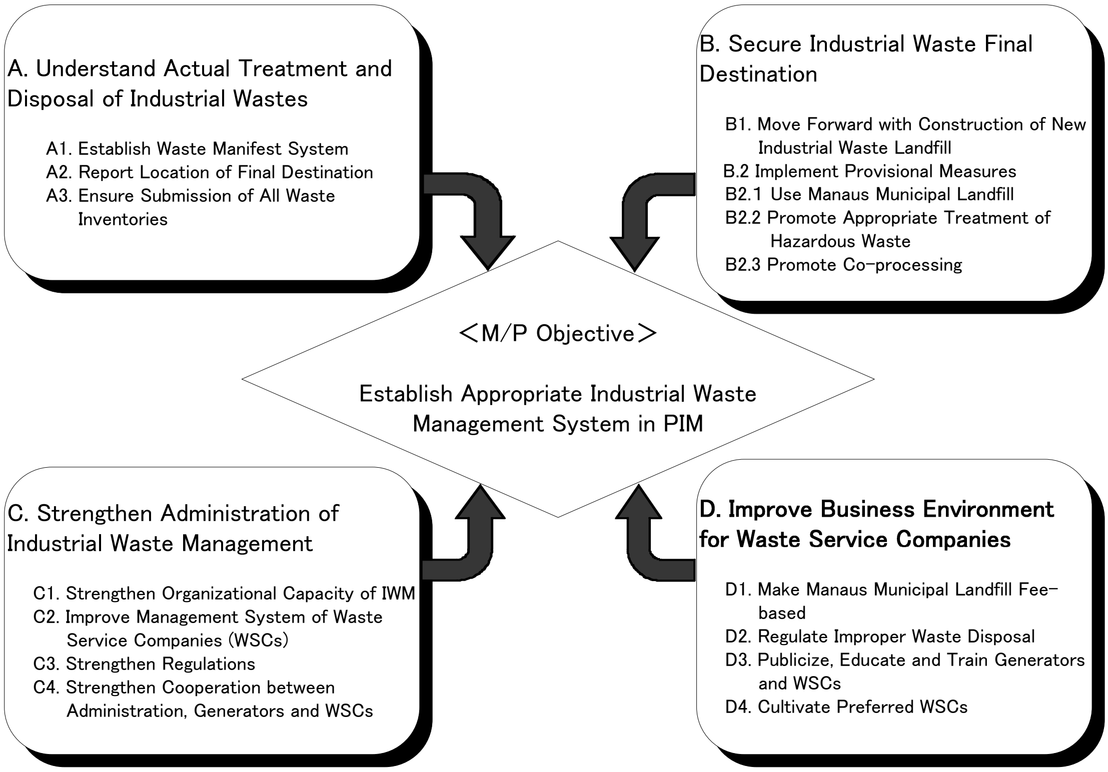


Figure 5-6: Summary of Master Plan Approach and Measure

Table 5-24: Summary of Master Plan

Approach & Measures	Objective	Content
Approach A. Understand Actual Treatment and Disposal of Industrial Waste • CONAMA Resolution 313 looks toward IPAAM to clarify the full spectrum of treatment /disposal of industrial wastes in the state of Amazonas and formulate an improvement plan. However, this has not yet been executed. • Understanding the full spectrum of treatment and disposal of waste generated from PIM is necessary /required for SUFRAMA to obtain an environmental license for DIs (Industrial Districts) as requested by the Public Ministry (PM) of Amazonas State.		
Measure 1. Establish Waste Manifest System	• IPAAM understands waste management conditions from factory discharge to final destination and manages it.	• IPAAM establishes a set format for a waste manifest in Amazonas State, collaborating with the INEA (State Institute of Environment) of Rio de Janeiro and others. • At the same time, work toward putting the waste manifest on-line.
Measure 2. Report Location of Final Destination	• Until the manifest system is established, IPAAM will understand and manage the final destination of factory waste.	• IPAAM requires generators (factories) to specify the final destination of industrial wastes on the application for operational license. • IPAAM requires all waste service companies to specify the final destination of wastes they are contracted to handle.
Measure 3. Ensure	• SUFRAMA raises the number of waste	• SUFRAMA constructs a system to manage waste inventories (WI).

Submission of All Waste Inventories	inventories submitted from 1/4th to 100%.	• Develop a waste inventory database (WI_DB). • Standardize WI reporting form in order to standardize input into WI_DB, and prepare guidelines. • Instruct factories to appoint a waste management officer that will prepare the waste inventory and submit to SUFRAMA. • Hold explanatory meetings for how to fill out waste inventories to ensure waste management officers at all factories understand the reporting forms. • Furthermore, arrange on-line preparation of WI and distribute the same input format to each factory.
Approach B. Secure Industrial Waste Final Destination • There are two landfills used as Final Destination for industrial waste generated in PIM, however neither has the proper operation license. Deciding how to secure Final Destinations is a major issue for PIM industrial waste management.		
Measure 1. Move Forward with Construction of New IW Landfill	• Construct a new industrial waste disposal site as the primary final destination for industrial waste generated in PIM as soon as possible.	• Create a system where waste generators bear the necessary disposal fee for the proper disposal of industrial waste. • Create an environment that promotes proper treatment and disposal by implementing a policy to eliminate improper disposal and prevent illegal dumping. • In addition to beneficial policies in the tax system, consider subsidies or other funding schemes for the construction of the landfill. • When planning the new industrial waste disposal site, make sufficient social and environmental considerations.
Measure 2. • Implement Provisional Measures until New Landfill is Operational		
Measure 2.1. Use of Manaus Municipal Landfill	• Use Manaus Municipal landfill as Final Destination until the new landfill is operational.	• Construct a dedicated site for Non-HIW & Non-inert industrial waste at one section of the Manaus Municipal landfill (ATRINI: Non-HIW & Non-inert Temporary Disposal Site). • Generators will pay a disposal fee for Non-HIW & Non-inert IW, which will be used to cover costs for construction and sustainable operation and management of ATRINI. • To promote the construction of ATRINI, SUFRAMA will work with the State Public Ministry (PM) to form a TAC (Terms of Agreement of Procedure) with Manaus City, IPAAM and other stakeholders.

		• After the Non-HIW & Non-inert Temporary Disposal Site (ATRINI) is constructed, Manaus City will only dispose of IW at ATRINI, which is strictly separate from the disposal site for municipal waste.
Measure 2.2. Promote Appropriate Treatment of Hazardous Waste	• Indicate measures and promotion methods for the appropriate treatment of hazardous industrial wastes.	• Promote co-processing which utilizes waste as fuel and /or raw material. • For hazardous industrial waste inappropriate for co-processing, detoxify at an IPAAM approved treatment facility and disposal of residue in ATRINI. • For HIW that cannot be treated, it will be taken to a treatment and disposal facility in another state, or properly stored on-site at the factory until a proper facility is prepared in Amazonas State.
Measure 2.3. Promote Co-processing	• Indicate promotion methods for co-processing, which is ideal for appropriate treatment /disposal of industrial waste.	• Indicate cement factory treatment methods for industrial waste and the measures necessary to do so. • In order to promote cement factory co-processing, it is necessary to foster companies (blenders) that will be able to blend the several kinds of wastes to be accepted by the cement factories.
Approach C. Strengthen Administration of Industrial Waste Management • There are personnel and technical vulnerabilities in the current system for IWM centred on IPAAM. Strengthening the administration of this system is a critical issue.		
Measure 1. Strengthen Organizational Capacity of IW Management	• Indicate a measure to strengthen IPAAM and SUFRAMA, which are responsible for IWM in Amazonas State.	• Appoint an officer in charge of IWM at the Environmental Monitoring Management Section (GMAM) at IPAAM. • The IWM officer will work with Information Analysis Management (GEAI) to develop and manage a database in which to enter and manage licenses of waste service companies (WSC_DB). • SUFRAMA will establish an Industrial Waste Management Group (IWM Group) and officially appoint IWM officers. • The IWM officers will work with the IT engineer (CGMOI: Modernization and Informatics General Coordination/SAD: Administration Deputy Superintendence) and develop a waste inventory database (WI_DB). • Analyze the data in the WI_DB and work with IPAAM to submit a PIM IWM Report to IBAMA and the State Public Ministry.
Measure 2. Improve	• Know the WSCs holding environmental licenses and the	• Enter WSCs currently using various activity codes under the newly established standardized codes (33 - -)

Management System of Waste Service Companies	activities therein and indicate a plan to eliminate non-licensed companies and activities.	and manage these. • Systemize conditions to obtain a license to operate as waste treatment company. • Instruct WSCs to obtain an operational license for collection and transportation, intermediate treatment, reuse and recycling, and final disposal as appropriate with their actual activities. • Develop a database of WSCs (WSC_DB) and enter approved companies. Make information on these approved WSCs available to waste generators. • Regulate both against generators contracting non-licensed companies and licensed companies conducting inappropriate treatment and disposal activities.
Measure 3. Strengthen Regulations	• Indicate measure for regulating inappropriate treatment/disposal.	• Make use of the database and its licensing and management system to promote regulation against improper treatment/disposal by WSCs. • Promote regulations against improper treatment/disposal through securing contractual agreements between waste generators and only licensed companies.
Measure 4. Strengthen Cooperation between Administration, Generators and WSCs	• Make a measure for administration, generators and waste service companies to collaborate in order to realize the "establishment of appropriate industrial waste management system".	• Promote cooperation between administration bodies. • Promote cooperation between administration and waste generators. • Promote cooperation between administration and waste service companies. • Strengthen cooperation between administration, generators, and waste service companies (WSCs).
Approach D. Improve Business Environment for Waste Service Companies • It is necessary to promptly improve the business environment currently restricting waste service companies and promote the proper treatment and disposal of industrial wastes.		
Measure 1. Make Manaus Municipal Landfill Fee-based	• Make the Manaus Municipal landfill, which accepts the largest amount of industrial waste, fee-based by collecting a fee necessary for appropriate disposal.	• SUFRAMA in cooperation with IPAAM will work with Manaus Municipality so that a dedicated site for Non-HIW & Non-inert IW can be constructed and make the necessary efforts to achieve construction. • Once it is constructed, SUFRAMA and IPAAM will work to ensure that Manaus City strictly manages the site to keep municipal waste separate from Non-HIW & Non-inert IW, and also so that a fee is collected to recover the necessary investment and operation costs.

Measure 2. Regulate Improper Waste Disposal	• Once the administration prepares a system for IWM, indicate a regulation measure against the improper treatment/disposal for industrial waste generators and WSCs to properly conduct these services.	• IPAAM will work with SUFRAMA for waste generators to recognize the need for costs corresponding with proper treatment and disposal. • IPAAM will strengthen its regulation against non-licensed entities. • IPAAM will strengthen its regulation against improper treatment/disposal by licensed companies.
Measure 3. Publicize, Educate and Train Generators and WSCs	• Indicate measure to publicize, educate and train waste generators and WSCs.	• IPAAM will actively publicize information on WSCs to waste generators (factories). • IPAAM will also provide training and guidance on technical information to promote the 3Rs in factories. • IPAAM will hold seminars for WSCs and provide training and guidance on technical information for appropriate treatment and disposal.
Measure 4. Cultivate Preferred Waste Service Companies	• Indicate measure to cultivate preferred waste service companies.	• Proactively inject good examples from advanced states such as Sao Paulo and improve the business environment for WSCs. • Consider introducing the system now used by many Prefectures in Japan for "Promotion of Preferred Waste Service Companies".

5.4.2 Understand Actual Treatment and Disposal of Industrial Waste

In order to obtain an environmental license for PIM requested by the Public Ministry of Amazonas State, it is necessary to get a clear picture of treatment and disposal of industrial waste generated from PIM. Surveys of 187 factories and 90 waste service companies were completed in this study to clarify the conditions and practices related to industrial waste; however, it was not possible to reveal the destination of residues from intermediate treatment, reuse and recycling activities. The following measures will be taken to resolve this point.

Measure 1. Establish waste manifest system

Measure 2. Report location of final destination

Measure 3. Ensure submission of all waste inventories

a. Establish Waste Manifest System

The waste manifest (WM) is the basic document used to facilitate the waste manifest system. The WM provides information about the wastes and their origin, transport, and destination, and establishes joint responsibility between the generator, transporter and receptor, including final destination of the waste. The diagram below visualizes the concept of the proposed waste manifest system.

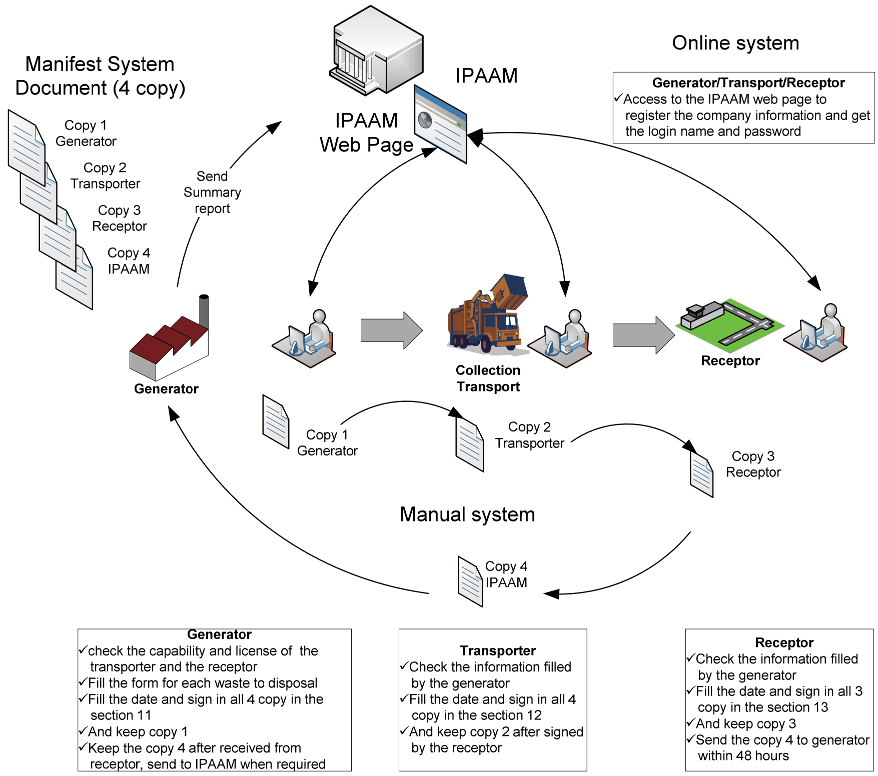


Figure 5-7: Proposed Waste Manifest System

The waste manifest (WM) is issued in four copies by the waste generator, who keeps one and sends the others to the transporter together with the waste. The transporter keeps one copy of the WM and delivers the waste and remaining two copies to the waste receptor. Finally, the receptor receives the waste, keeps one copy of the WM and returns the last one back to the generator, completing the cycle. IPAAM will indicate which sheet will remain with each respective party.

Although the generator issues the original WM, a manager will be contracted to oversee the service. The WM should be issued specifically for each type of waste, even when several types are transported in a same load or when several loads of the same waste are transported together. Furthermore, even when several loads are transported by the same transporter or delivered to the same receptor, each load should be accompanied by a specific WM.

IPAAM will designate a unique serial number for each set of the waste manifest (4 copies) which also identifies the waste generator. This is to prevent fraud, such as any deviation from the required protocol.

All generators, transporters and receptors, public or private, in the waste manifest system will be linked to the IPAAM web page. Since the generator may receive the 4th copy of the WM, and as such, will be show up twice, IPAAM will need to define the relationship of the four (4) copies each time to avoid confusion.

The protocol of transferring and receiving the wastes within the waste manifest system is established specifically in each case at the discretion of IPAAM depending on the hazard and the amount of wastes generated by a factory's activities. General and public solid wastes are usually excluded, so the system is applied to the industrial plants' systems and their health services as well as the owners of construction sites, but excludes the domestic waste generated in those plants.

IPAAM will supply the generator with instructions, together with the serial number, and the forms or a model to make the forms.

The waste manifest form used in Rio de Janeiro is shown in the following figure.

feema

MANIFEST OF WASTES N.__________

WASTE			QUANTITY ....tons ....m^3
PHYSICAL ASPECT	ORIGIN	( ) Process ( ) ETI ( ) ETE ( ) ETA ( ) Fat Pit	
( ) Solid ( ) Semi-solid ( ) Liquid		( ) Out of Process ( ) Water-Oil Separator ( ) Others, specify__________	
STOWAGE	SOURCE	TREATMENT / DISPOSAL	
( ) Drum of 200 lts. ( ) Plastic bags ( ) Barrel ____ (lts) ( ) Loads ( ) Dumper truck ( ) Bulk ( ) Tank ____(m^3) ( ) Big-bags ( ) Others, specify __________	( ) Industrial ( ) Domestic ( ) Restaurant ( ) Shopping/Markets ( ) Commercial ( ) Clubs/Hotels ( ) Hospital ( ) Others, specify __________	( ) Sanitary Landfill ( ) Recycling ( ) Industrial Landfill ( ) Incorporation ( ) Biol./Phy-Che.Treatment ( ) Incineration ( ) Co-processing ( ) Stowage ( ) Others, specify __________	

Generator

COMPANY NAME			N. INVENTORY	__/__/__ DELIVERY DATE
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF RELEASING THE WASTE		POSITION		STAMP AND SIGNATURE OF THE PERSON IN CHARGE

Transporter

COMPANY NAME				__/__/__ RECEIVING DATE
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF THE TRANSPORTATION COMPANY		VEHICLE	COMPLETE PLATE NUMBER	
NAME OF THE DRIVER		VEHICLE	CERTIFICATE OF INMETRO	SIGNATURE OF THE DRIVER

Receptor

COMPANY NAME				__/__/__ Receiving Date
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF RECEIVING THE WASTE		POSITION		Stamp and signature of the Receiver

1st Sheet – To be kept by the Generator

THE GENERATOR SHOULD:	- fill out for each generated and disposed waste, all the fields, except the fields regarding the date and signature of the transporter and receiver; - date and sign field 11 in all the 4 sheets; - file the 1st sheet, after being dated and signed by the transporter; - deliver the other sheets to the transporter; - obey the sequential numbering strictly, sending to FEEMA the manifests which are disabled; - deliver to the transporter the Plan of Emergency, when it has to do with the transport of hazardous wastes; - file the 4th sheet of the Manifesto, received from the receptor, submitting it to FEEMA whenever requested; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the generator: company name, location, telephone, fax, e-mail, legal and representative and technician in charge; 2. list with the numbers of the manifests, identification of the waste, physical state, hazardous characteristics, destination system, form of stowage, amount, identification of the transporter and receiver; 3. list of the numbers of the disabled manifests.
THE TRANSPORTER SHOULD:	- confirm the information contained in all the fields; - date and sign field 12 in all the 4 sheets, in the presence of the generator; - file the 2nd sheet after being dated and signed by the receiver; - deliver the other sheets to the receiver; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the transporter: company name, location, telephone, fax, e-mail, legal representative, type of trucks and complete plates numbers; 2. list with the number of the manifests of the transported wastes, identification of the waste, physical state, form of stowage, amount, dates, identification of the generator and receptor.
THE RECEPTOR SHOULD:	- confirm the information contained in all the fields and inform FEEMA if divergences are found; - date and sign field 13 in the last 3 sheets, in the presence of the transporter; - file the 3rd sheet; - send the 4th sheet to the generator, within 48 subsequent hours to the reception of each waste; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the receptor: company name, location, telephone, fax, e-mail, legal and representative and technician in charge; 2. list with the number of the manifests of the received wastes, identification of the waste, physical state, form of stowage, destination system adopted, quantity, date, identification of the generator and transporter.

Figure 5-8: Waste Manifest form (FEEMA - Rio de Janeiro)

b. Reporting Location of Final Destination

The State of Amazonas requires an operational license to be issued to create and submit the forms needed for a waste manifest. During the period until a waste manifest system has been established, IPAAM (administrator) shall demand both the Factory (generator) and the WSC (receptor) to report a final destination for their waste as follows:

- The Final Destination for industrial waste generated from PIM in the State of Amazonas will be one of the following.
  1. One of two final disposal sites in the area, although they are without environmental licenses.
  2. Cement factory or co-processing which uses waste was construction material.
  3. Treatment and disposal outside of the State of Amazonas.
- IPAAM will instruct the generator to require receptors of their waste, including collectors, recyclers and intermediate treatment operators, to report final destination. Then require that the final destination of wastes be written on the application for operational license.
- IPAAM will instruct all waste service companies (receptors) to report the final destination of wastes to the factories where the wastes were generated. Then require that the final destination of wastes they were contracted to receive is written on the application for operational license.

The above framework is shown in the figure below. IPAAM will cooperate with SUFRAMA to aggregate the final destinations reported by both the generator and receptor, check this against the waste stream made in this study, and clarify any resulting issues.

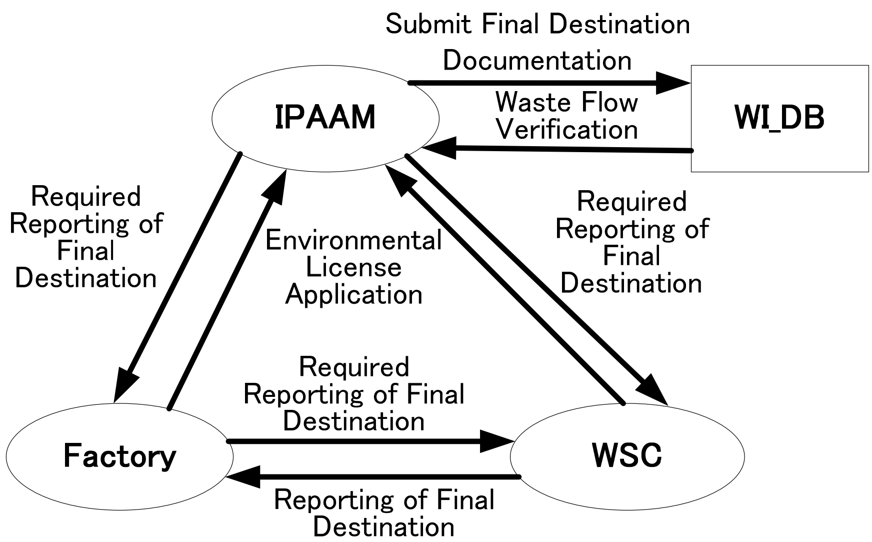


Figure 5-9: Final Destination Reporting and Application

c. Ensure Submission of All Waste Inventories

The following measures will be taken to ensure that all PIM factories submit waste inventories (WI).

- At SUFRAMA, the "Industrial Waste Management Group (IWMG)" will cooperate with CGMOI to construct a system to manage waste inventories.

- Each factory will designate someone who is responsible for waste management, who will prepare the WI and submit it to SUFRAMA.
- Establish reporting forms needed for the database management system created in this study.
- Hold a seminar on the proper way to fill in the reporting forms so that the person responsible for waste management at each factory can understand.
- Furthermore, distribute an electronic format of the same form to each factory so that each factory can enter and submit the waste inventory online.

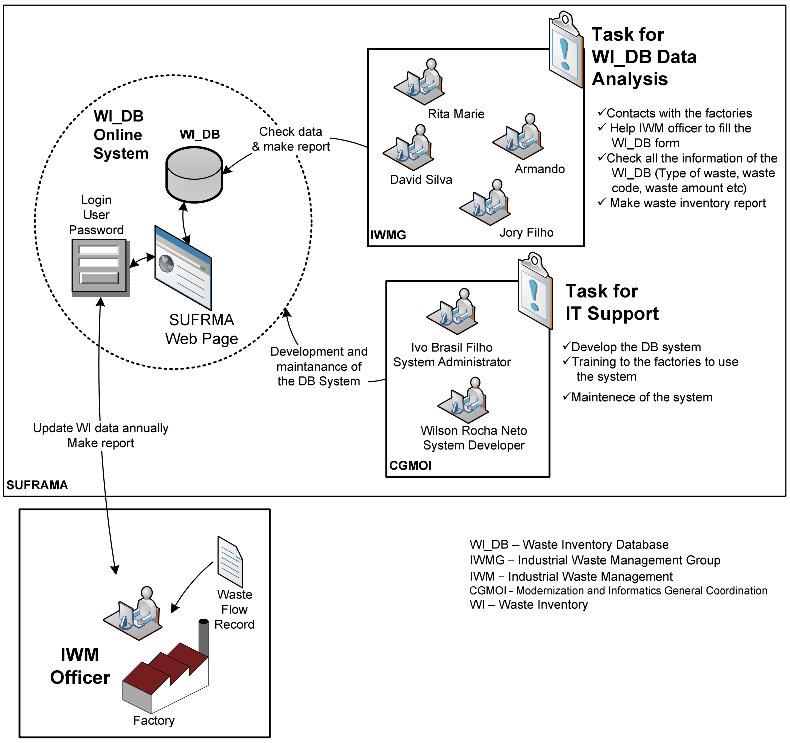


Figure 5-10: Waste Inventory Management Structure

5.4.3 Secure Industrial Waste Final Destination

The following measures will be taken in order to ensure final destination for industrial waste from the PIM factories.

Measure 1. Move forward with construction of new industrial waste landfill

Measure 2. Implement provisional measures until new landfill is operational

During the period until a licensed final destination has been constructed, take the following measures.

Measure 2.1 Use Manaus municipal landfill

Measure 2.2 Promote appropriate treatment of hazardous waste

Measure 2.3 Promote co-processing

a. Move Forward with Construction of New Industrial Waste Landfill

a.1 Waste and Landfill Categories

The following table shows the categorization of wastes that are accepted in landfills in Brazil.

Table 5-25: Waste types and landfills in Brazil

Target Landfill Type	Landfill/ABNT/NBR Guideline*1	Remarks
1. Hazardous Waste (Class I waste)	• Hazardous Waste Landfill • NBR 10157/87 – Landfill for Hazardous waste (Class I waste)	• Equivalent to a strictly controlled landfill in Japan. As in Japan, Brazil has few of these authorized landfills. There are some in Sao Paulo State and Paraná State. • Presently, in more developed states like Sao Paulo, Rio de Janeiro --and similar to Japan -- direct disposal (without treatment) of hazardous wastes is discouraged.
2. Class II-A/ non-inert industrial waste	• Non-hazardous waste landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• Equivalent to a controlled landfill in Japan. • ABNT/NBR guidelines have only two standards: hazardous and non-hazardous. Therefore, non-hazardous industrial waste and non-hazardous municipal waste have the same landfill standard. However, depending on the State, non-hazardous, non-inert industrial waste landfills have a different standard than municipal landfills. It is recommended that the municipal landfill be separate and strict management and monitoring appropriate to the standard be observed.
3. Class II-A & B/ municipal waste	• Municipal Landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• Equivalent to a controlled landfill in Japan. • The ABNT/NBR guidelines are the same as non-hazardous wastes.
4. Class II-B/ inert industrial waste	• Non-hazardous waste landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• In Brazil, there is no equivalent to Japan's standard for stable landfill. It is the same as non-hazardous and municipal garbage landfill. • Even in strictly run states, if an item can be verified to be inert, it is accepted at the municipal landfill.

Note: *1: Not CONAMA but a standard[1] established by each state according to ABNT/NBR guideline

[1] In Rio De Janeiro State INEA (Ex-FEEMA) established the following standards for landfill:
- DZ 1311 – Destination of IW
- IT 1304 – Licensing of industrial landfill
- DZ 1313 – Impermeabilization (bottom and upper liner) of landfills

a.2 Develop a Landfill on a Priority Basis

At present, the municipal landfill is operating even though it has not obtained an environmental license, yet it has accepted a large amount of industrial waste. It is essential to have a place of final disposal responsible for municipal waste management and related agencies are now working to move ahead with the construction of an municipal waste landfill with a operation license and, separately, industrial waste management.

An industrial waste landfill differs from a municipal waste landfill in that the risk of hazardous waste entering the site. To avoid hazardous waste the industrial waste landfill is carefully chickening waste characteristics prior to accepting it for disposal. On the other hand, the municipal waste landfill is not checking the incoming waste. In accordance, there is a considerable risk that the municipal landfill is receiving hazardous industrial waste for disposal if it accepts industrial waste. In order to avoid such a risk, it is necessary to dispose of industrial waste in a dedicated landfill of its own.

Waste would be roughly divided into the following 3 categories for an industrial waste landfill, using waste categories in Brazil.

1. Hazardous Industrial Waste (HIW): Class I HIW
2. Non-hazardous and non-inert industrial waste: Class II-A: Non-HIW /Non-inert
3. Non-hazardous and inert industrial wastes: Class II-B: Non-HIW /Inert

Of these, if the waste can be proven to be non-hazardous, inert industrial waste, there is no problem to dispose of it in the municipal waste landfill. For hazardous waste, it should be treated (detoxified) as much as possible before disposal, as is done in Japan and developed States of Brazil. Also, according to estimates, generation amount of HIW is limited to 119.9 ton/day in 2009 and 157.5 ton/day in 2015; it should be reduced and treated through co-processing and intermediate treatment as much as possible. For items that present extraordinary challenges to treat, they should be transported to another State for treatment and disposal.

Based on the above statements, a non-hazardous, non-inert (Class II A: Non-HIW /Non-inert) industrial waste landfill should be prepared as soon as possible. A hazardous industrial waste landfill is also of great importance, however dealing with any accidents that could happen would create a significant challenge, it is necessary to make careful considerations and prepare a great deal of time to select the site, carry out environmental, natural and social surveys, make the basic design, conduct an EIA, hold a public hearing, do the actual facility design, and construct it.

For the planning and design of non-inert (Class II A: Non-HIW /Non-inert) industrial waste landfill, the following standards made by CETESB/SP (Lo Companhia Ambiental Do Estado De Sao Paulo, Environmental Company of State of Sao Paulo) could be referred due to the lack of a federal standard:

- Rules for the environmental/geological evaluation of the site chosen for the landfill (Norma para avaliação geológica/ambiental do sítio escolhido para aterro de resíduos)
- Project standard for industrial waste landfill (Norma para projeto de aterro industrial)

As for the planning and design of a hazardous industrial waste landfill NBR 10157 Dec/1987 (Hazardous Waste Landfills – Criteria for design, construction and operation) shall be referred.

a.3 Promote the Construction of a New Industrial Landfill

In Brazil as well as Amazonas State the government has a policy not to develop a new industrial waste landfill by themselves. Instead they promote a private company to develop it. The construction and operation of a new landfill will require a massive investment and operation costs. A private company will have to collect an appropriate disposal fee from users so that they can recover their investment and carry out proper disposal practices. In order to facilitate the construction of a landfill by a private company, SUFRAMA and IPAAM should cooperate with the Municipality of Manaus and FIEAM and others according to the following measures.

- The Manaus city landfill currently disposes industrial waste free of charge. As long as these conditions persist, the environment is not welcoming to an investor that might construct an industrial waste landfill that can properly dispose of such waste. This is also important to encourage generators of waste to practice the 3Rs and reduce their waste. Therefore, a system to charge for disposal should be introduced, quickly constructing the framework where dischargers bear the necessary cost to dispose of waste properly.
- Appropriate treatment and disposal comes hand-in-hand with a reasonable cost burden. In order to foster an environment that promotes appropriate treatment and disposal, it is necessary to implement measures that eliminate improper disposal and prevent illegal dumping.
- Upon implementing the above measures, to construct a new landfill, it is necessary to explore tax benefits and financial aid schemes such as subsidies.

When planning the new industrial waste landfill, it will be necessary to make the following social and environmental considerations.

Social Environment:

- Does not require resident relocation. Furthermore, select an area apart from residential areas to the greatest extent possible.
- Locate the site in an area apart from the airport whilst minimizing the transportation distance from PIM.
- Select an area that will not affect public facilities or cultural sites.
- Select an area that does not cause community severance, such as a natural conservation area.
- Select an area with minimal potential impact on natural disaster by avoiding steep slopes.

Natural Environment:

- Select an area with little impact on the ecosystem.
- Avoid areas susceptible to soil erosion, and select an area with minimal potential impact on geological features.
- Select an area that will not affect groundwater, lakes or rivers (igarape).
- Select an area that will not impact the local landscape.

Pollution Countermeasures:

- Take sufficient air pollution control measures such as dust prevention measures.
- Make a thorough investigation into groundwater, lakes and river (igarape) water pollution prevention measures.
- Take sufficient measures against soil contamination.
- In the construction stage, propose a plan to alleviate negative affect of construction, such as air pollution, noise pollution and water pollution.

b. Implement Provisional Measures until New Landfill is Operational

b.1 Use Manaus Municipal Landfill

b.1.1. Construction of ATRINI: Non-HIW & Non-inert Temporary Disposal Site

Manaus City landfill is in principle non-hazardous and disposes of industrial waste discharged from PIM along with municipal waste. Also, there is no disposal fee collected, so there is little reason for dischargers to reduce their waste, and recyclable waste is disposed of without recycling.

As mentioned above, in order to avoid the risk of mixing hazardous industrial waste for disposal, it is necessary to carefully manage the characteristics of the wastes accepted separately from municipal waste. Thus, it is necessary for IPAAM to work with SUFRAMA and FIEAM to construct a special Non-HIW & Non-inert IW temporary disposal site (ATRINI) in the municipal landfill, asking that non-HIW and non-inert waste be carefully managed apart from municipal solid waste and non-HIW and inert waste, and provide support for construction. The discharger will bear the disposal fee, an amount that will cover the construction and sustained operation of the site (ATRINI). The fee for appropriate disposal will encourage dischargers to reduce their costs, increasing the necessity to reduce through recycling and thus contribute to the promotion of 3R. The concept of the non-HIW and non-inert industrial waste disposal site is shown in the figure below.

Also, to promote its construction, IPAAM will have to work with the state's Public Ministry to make a Terms of Agreement Procedure (TAC) with the concerned parties such as the Municipality of Manaus and SUFRAMA.

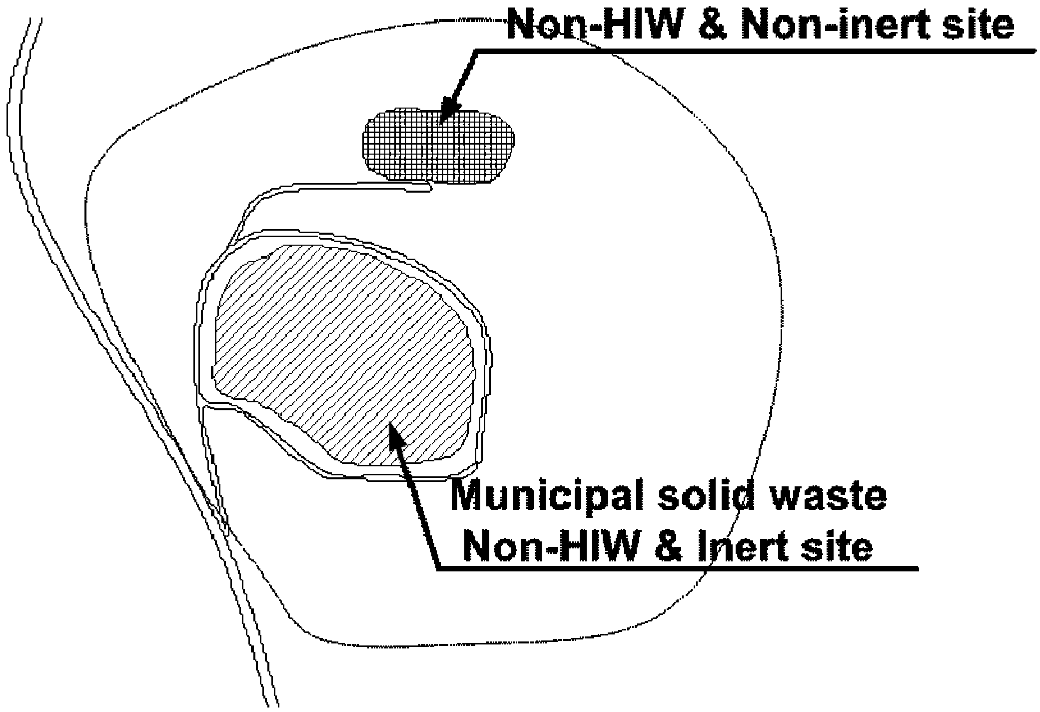


Figure 5-11: Conceptual Drawing of the Dedicated Site for Non-HIW and Non-inert IW

Also, for the construction of a dedicated site for non-hazardous and non-inert industrial waste, consideration is given to the following points.

- Forecasting the amount of municipal waste and non-hazardous, non-inert industrial waste that will enter the site, calculate the area of the landfill sections that will be required for both.
- Select a location to landfill non-hazardous, non-inert industrial waste that will minimize any impact on the surrounding area and take any necessary environmental countermeasures.
- Design the ATRINI (Non-hazardous & non-inert industrial waste temporary disposal site) according to the project standard[1] made by CETESB/SP (Lo Companhia Ambiental Do Estado De Sao Paulo, Environmental Company of State of Sao Paulo) due to the lack of a federal standard for the design of a non-hazardous & non-inert industrial waste disposal site.
- Construct an enclosure around the perimeter of the non-hazardous, non-inert industrial waste to specify the section for final disposal.
- Assign attendants to direct collection vehicles to the proper place to dump non-hazardous, non-inert industrial waste separately from municipal waste.
- Operate the ATRINI according to the operation standard[2] made by CETESB/SP because there is no federal standard for the operation of a non-hazardous & non-inert industrial waste disposal site.

[1] Project standard for industrial waste landfill: Norma para projeto de aterro industrial

[2] Operation standard for industrial waste landfill: Norma para operação de aterro industrial

- Conduct regular surveillance of landfill section for non-hazardous, non-inert industrial waste.

b.1.2. Ensured Industrial Waste Management

After constructing the non-HIW & non-inert temporary disposal site (ATRINI), the city of Manaus will rigorously manage the disposal of industrial waste at that site as follows:

1. Prohibit the disposal of hazardous industrial waste (HIW), and keep strict restriction on transportation.
2. Non-HIW & Non-inert waste is disposed of at ATRINI, establish and collect the fees needed for necessary costs (construction, operation, etc). The entrance to the hauling roads to the ATRINI and municipal waste sites will be separate and marked so the proper road is clear after weighing is completed.
3. Non-HIW & Inert waste, if clearly marked by the IPAAM, will be disposed of at the municipal waste site. A separate fee will be established from that for Non-HIW & Non-inert waste.

b.2 Promote Appropriate Treatment of Hazardous Waste

Until the new disposal site is operating, the following measures will be taken for a final destination for hazardous industrial waste.

1. First, promote co-processing to use waste as fuel or raw materials.
2. HIW that can not be co-processed will be treated at an IPAAM-approved facility and the residue disposed of at ATRINI.
3. For HIW that can not be disposed of by the above methods, they will be transported to a treatment/disposal facility in another state, or properly stored within the factory until an appropriate treatment/disposal facility is constructed in the Amazonas State.

The above policies for hazardous industrial waste are shown in the figure below along with non-HIW final destination (FD).

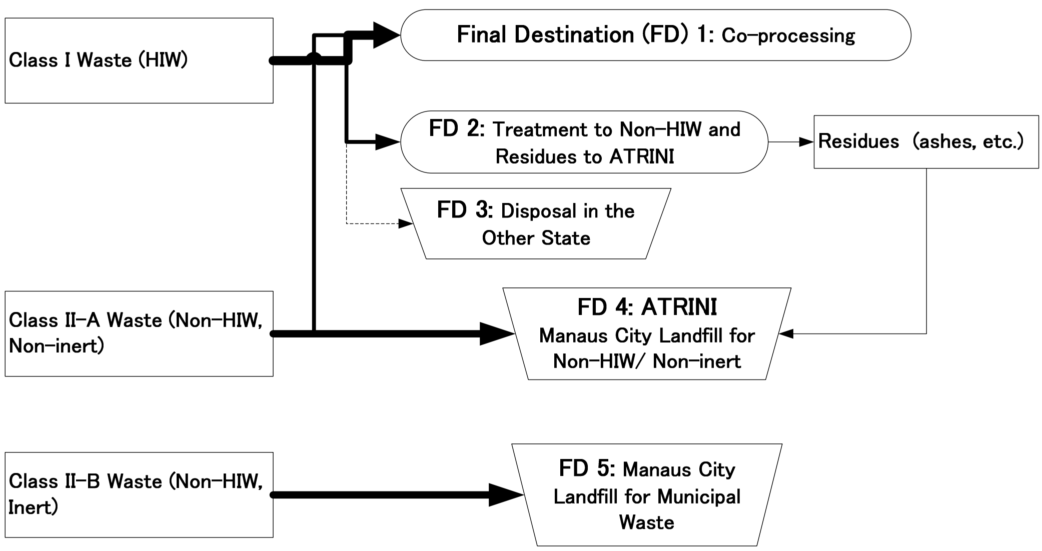


Figure 5-12: Industrial Waste Final Destination (FD)

b.3 Promote Co-processing

Co-processing is the use of waste as raw material, as a source of energy, or both, to replace natural mineral resources (material recycling) and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes, mainly in energy intensive industries (EII) such as cement, lime, steel, glass, and power generation. Waste materials used for Co-processing are referred to as alternative fuels and raw materials (AFR).

b.3.1. Concept of Co-processing

Co-processing is a proven sustainable development concept that reduces demands on natural resources, reduces pollution and landfill space, and thus contributes to reducing the environmental footprint. Co-processing is also based on the principles of industrial ecology, which considers the best features of the flow of information, materials, and energy of biological ecosystems, with the aim of improving the exchange of these essential resources in the industrial world.

The following table presents types of co-processing:

Table 5-26: Types of Co-processing

Types of Waste	Types of Recovery	Substitution	Examples
Energy Content Waste (Carbon, hydrogen)	Energy	Fossil energy	• Paint & Solvents • Waste oil • Waste plastics
Both Energy (Carbon, hydrogen) and Material Content Waste (CaO, Fe_2O_3, Al_2O_3, etc.)	Energy and Material	Fossil energy Raw material	• Waste tire
Material Content Waste (CaO, Fe_2O_3, Al_2O_3, etc.)	Material	Raw material	• Sludge • By-product gypsum • Molding sand • Slag

b.3.2. Benefits of Co-processing

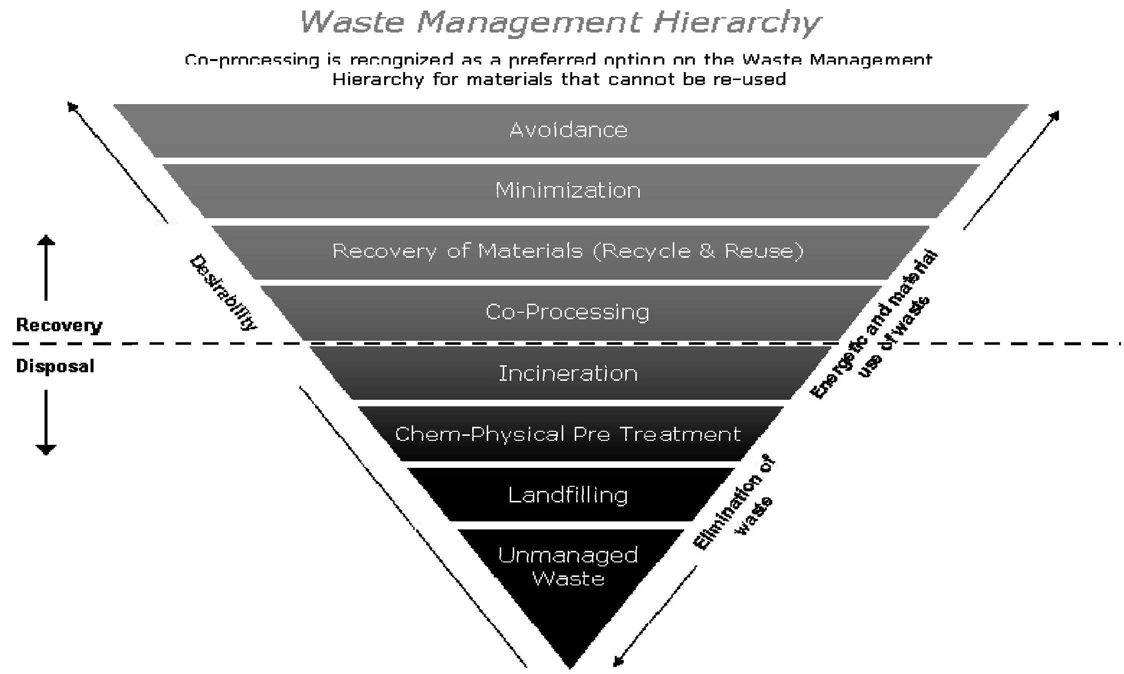
In summary, the benefits of co-processing are:

- to conserve natural (non-renewable) resources of energy and materials,
- to reduce emissions of greenhouse gases in order to slow global warming and demonstrate a positive impact on integrated environmental indicators, such as the ecological footprint,
- to reduce the environmental impacts of the extraction (mining or quarrying), transporting, and processing of raw materials,
- to reduce dependence on primary resource markets,
- to save landfill space and reduce the pollution caused by the disposal of waste, and
- to destroy waste completely eliminating potential future liabilities.

b.3.3. Waste Management Hierarchy

Co-processing contributes to the industrial competitiveness, is a complementary technology to concepts such as cleaner production or recycling and should be considered as a treatment alternative within an integrated waste management concept. Some energy intensive industries offer co-processing as a sustainable waste management service. It is usually more cost effective to adapt existing facilities of energy intensive industries than building new waste treatment capacities thereby reducing waste management cost to society.

The waste management hierarchy (see figure below) shows that Co-processing is a recovery activity which should be considered after waste minimization and recycling; Co-processing ranks higher in this hierarchy in comparison to disposal activities such as landfilling or incineration.



Source: Guidelines on Co-processing Waste Materials in Cement Production (GTZ- Holcim Ltd,), March 2005

Figure 5-13: Waste Management Hierarchy

b.3.4. Co-processing Waste in Cement Production

Different types of wastes have been successfully co-processed as alternative fuels and raw materials (AFR) in cement kilns in Europe, Japan, USA, Canada, and Australia since the beginning of the 1980s.

Main destinations of wastes in co-processing in the cement factory are;

- Organic substances: Thermal destruction in the kiln
- Heavy metals: Incorporation in the clinker

Main constituents of the clinker, which is semi-fabricated material of the Portland cement, are the following four components: CaO, SiO_2, Al_2O_3 and Fe_2O_3.

Waste and/or by-products, which contain these four components to some extent, are theoretically able to be utilized as raw material for Portland cement.

Normally cement kilns use coal as fuel. Wastes and or by-products having a certain level of calorific value can be used a substitute of fuel. In addition, ashes generated from these combustible wastes and by-products are incorporated into the clinker. No new wastes generated characterize co-processing in the cement kiln. Furthermore, in the firing process in the kiln, temperature and retention time at the main burner are generally more than 1,450 ℃ and more than 15 seconds respectively. Many types of hazardous wastes and products can be safely changed to non-hazardous material at this high temperature. However, in case, these wastes and/or by-products contain chlorides, alkaline component and heavy metals, it is necessary to correspond to these cases.

Table 5-27: Example of constituents of the Portland cement product, raw material and wastes

		Main chemical components (%)			
		SiO_2	Al_2O_3	Fe_2O_3	CaO
Standard Portland Cement		20～23	3.8～5.8	2.5～3.6	63～65
Natural raw material	Limestone	～4	～2	～2	47～55
	Clay	45～80	10～30	3～10	～5
	Silica stone	70～95	2～10	～5	5～20
Wastes and by-products	Coal ash	40～65	10～30	3～10	5～20
	Blast furnaces slag	20～45	10～20	～5	30～60
	Sludge (e.g. sewer sludge)	20～50	20～50	5～15	5～30
	Molding sand	50～60	5～15	5～15	～5

Source: Chiaki Sasaki, Taiheiyo Cement

According to the annual report in 2007 of the National Association of Cement Industry (SINDICATO NACIONAL DA INDUSTRIAL DO CIMENTO), the present status of co-processing in the cement industry is mentioned as follows. In Brazil, the first practices took place from the 90s on, and CONAMA Resolution 264/1999 was established in 1999 as the legal framework for co-processing. Out of the existing 65 cement plants, 48 are integrated factories, i.e., with kilns for the production of clinker, and another 17 plants have grinding facilities of clinkers and mixing facilities of gypsum; however they don’t have kilns.

Out of the 48 integrated factories, 35 are properly skilled and licensed by the environmental organizations of the located states to co-process wastes The country generates around 2.7 million tons of hazardous waste a year, coming from the most varied industrial sectors, many of those do not treat and dispose by any proper environmental treatment and thus, in the end it is contaminating the soil, the air and both underground and surface waters. Current capacity of co-processing of hazardous wastes is two million and five hundred thousand tons per year (2.5 million tons). The industry treated one million tons of hazardous wastes in 2007. It was under current capacity.

The main wastes co-processed by cement industry are as follows:

- Waste plastics
- Waste refractory products
- Acid dusts
- Waste paper and cardboard
- Contaminated soil
- Wooden wastes
- Construction wastes
- Waste oils and grease
- Waste paints and solvents

- Petrochemical wastes
- Dust
- Waste tires
- Wastewater treatment sludge

One of the main wastes co-processed by the industry are waste tires, which are observed dumped on the rivers banks and unused lands. Only in 2007, around 1.6 thousand tons of waste tires were utilized in cement kilns as a substitute of fuels; corresponding to approximately 32 million tons per year.

As stated above, utilization of co-processing service of waste in cement kilns holds in CONAMA Resolution 264/1999 as the federal government level. In addition, at the Amazonas state level, the co-processing of wastes includes categorization of pollutant sources in granting of the environmental licenses by IPAAM. Therefore the co-processing of wastes is clearly defined by law and rule. In CONAMA Resolution 264/1999, the following permits and licenses are required in order to acquire permit of co-processing operation.

- Installation license of the kiln based on the federal regulation
- Acceptance of combustion test of the kiln
- License or permit based on the state regulation where the kiln is located

Emission standards of exhaust gas from cement kiln in co-processing of wastes should be applied in the standard in the CONAMA Resolution No. 264/99.

Table 5-28: Emission standards of exhaust gas from cement kiln in co-processing of wastes

Parameter	Maximum emission standard
HCl	1.8kg/h or 99 % reduction
HF	5 mg/Nm^3
CO	100 ppm (one hour value)
Particulate Matter	70 mg/Nm^3
THC (as propane)	20 ppm
Hg	0.05 mg/Nm^3
Pb	0.35 mg/Nm^3
Cd	0.10 mg/Nm^3
TI	0.10 mg/Nm^3
As+Be+Co+Ni+Se+Te	1.4 mg/Nm^3
As+Be+Co+Cr+Mn+Ni+ Pb+Sb+Se+Sn+Te+Zn	7.0 mg/Nm^3

Note: Oxygen concentration is 7% (dry base) except particulate matter. Oxygen concentrate of maximum emission standard of particulate matter is 11% (dry base)
Source: CONAMA Resolution 264-1999

Mixing and pre-storage company for co-processing in the cement kiln is obliged to acquire an environmental license from the competent authority of the state government. In this regard, the company should provide the following information to the competent authority.

- Name of company and address of plant
- Main products and services
- Location of acceptance of wastes, laboratory, storage and disposal facilities (including plan hereafter)

- Description about procedure of acceptance of wastes, sampling & analysis, storage and treatment of generated residues
- Classification, characteristics, amount and treatment method of in-coming wastes
- Physical and chemical analysis results of in-coming wastes, plan of analysis
- Facility and procedure of safety management
- Risks upon loading and unloading of wastes, risks upon opening of package, effect of breakdown of equipment and blackout, exposure of wastes
- Prevention measures for accidental firing and reaction of combustible, reactive and rejected wastes
- Transportation pathway of wastes in the plant
- Plan in case of closure of plant and plan after closure of plant
- Wastewater treatment system

b.3.5. Co-processing in the cement industry in Manaus

There is only one cement producer in the state of the Amazonas. This company commenced operation in 1986. It is one of ten cement plants of the Joao Santos group which is the second largest cement producer in Brazil. According the National Association of Cement Industry, its production amount of Portland cement in 2007 was 683 thousand tons. They have one kiln 4.4m in diameter×74m in length. In the questionnaire survey, they answered that the waste they accept is mainly waste tires, foundry sand and treatment sludge. At this moment, they are unable to calculate how many tons of acceptable wastes are generated in this area and they are not sure of the continuity of receiving acceptable wastes in the future. Therefore they may not start full-scale co-processing business at this moment. In addition, co-processing may face cost competition with incineration service and final landfill.

b.3.6. Situation of co-processing of wastes in the cement industry in Japan

The cement industry in Japan has been treating and utilizing several types of wastes. The table below shows the amount of wastes and by-products co-processed in the industry. The industry utilized approximately 31 million tons of wastes in 2007, which is equivalent to 43.5 % of the amount of cement products. Japan is continuing with “3R which is Reduce, Reuse and Recycle of wastes” to establish a recycling-oriented society. The concept of industrial clusters is drawing attention at this moment as one of the measures for establishing the recycling-oriented society. The concept of industrial clusters is to reduce the wastes through the linkage of industries. In this process, the generated wastes (output) from one industry are converted to resources (input) of other industry.

Since the cement industry can utilize a variety of wastes from many industrial sectors, the industry is recognized as an important industry and one of the core industries in a recycling-oriented society. In addition, the industry currently accepts ash of municipal wastes. Then the industry produces special cement of which incineration ashes of municipal wastes and sewage sludge are the primary raw material.

Table 5-29: Historical record of amount of products and wastes utilized in the Japanese cement industry

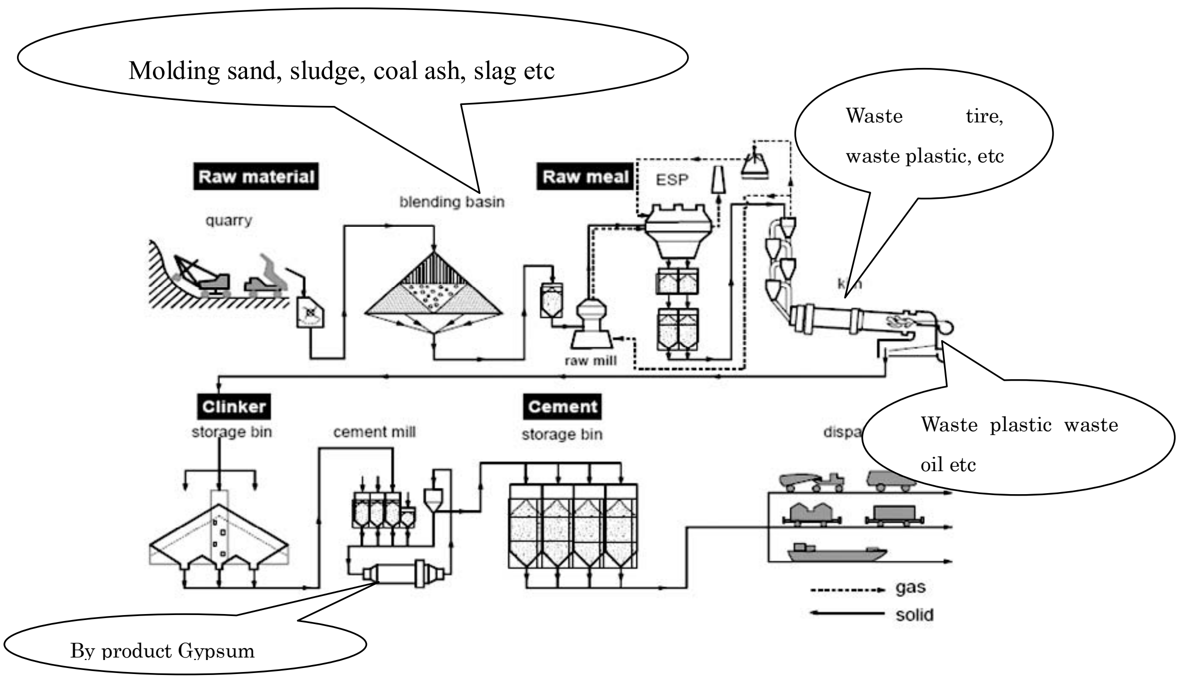
Unit: thousand ton/year

		2000	2001	2002	2003	2004	2005	2006	2007
Waste	Blast furnace slag	12,162	11,915	10,474	10,173	9,231	9,214	9,711	9,304
	Coal ashes	5,145	5,822	6,320	6,429	6,937	7,185	6,995	7,256
	By-product gypsum	2,643	2,568	2,556	2,530	2,572	2,707	2,787	2,636
	Waste oil	359	353	352	411	450	447	474	479

	Waste wood chips	2	20	149	271	305	340	372	319
	Waste plastics	102	171	211	255	283	302	365	408
	Waste tires	323	284	253	230	221	194	163	148
	Others	6,623	6,928	6,923	7,265	8,781	9,124	10,181	10,170
	Total	27,359	28,061	27,238	27,564	28,780	29,513	31,048	30,720
	kg/ton-cement	332	355	361	375	401	400	423	436
Cement Product	Production	82,373	78,119	75,479	73,508	71,682	73,931	73,170	70,600
	Rate(Waste/Cement)	33.2	35.9	36.1	37.5	40.1	39.9	42.4	43.5

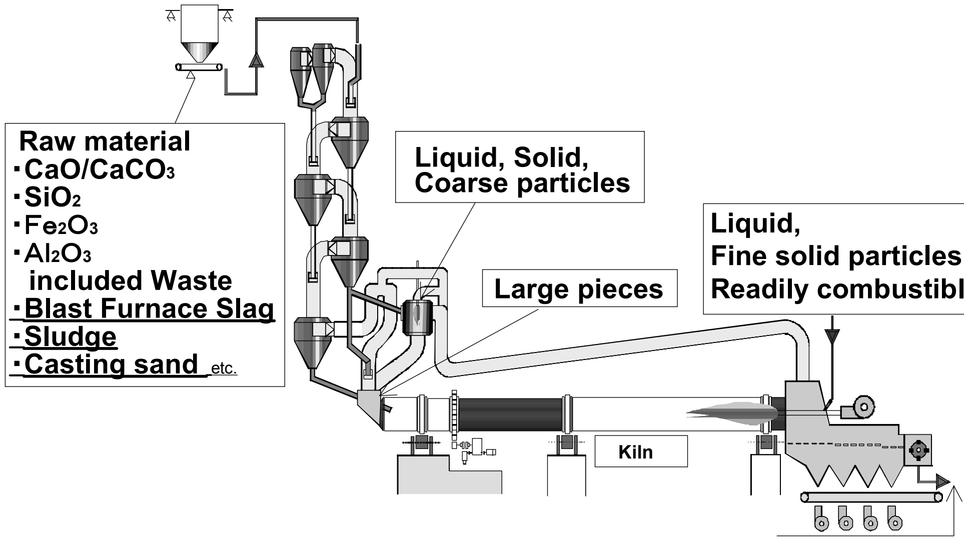
Source: "Cement Sector Actions through the Asia-Pacific Partnership on Clean Development and Climate", Taiheiyo Cement Corporation, Japan Cement Association

The following figure shows the types and feeding places of waste in a cement plant. The figure also illustrates the relationship of the cement plant and the blenders of the wastes. Characteristics of each waste and sources are different so, in order to accept many kinds and sources of wastes, it is necessary to mix and regulate the constituents and convert them to be acceptable for the cement plant. These blenders of wastes are taking active roles in the waste management business.



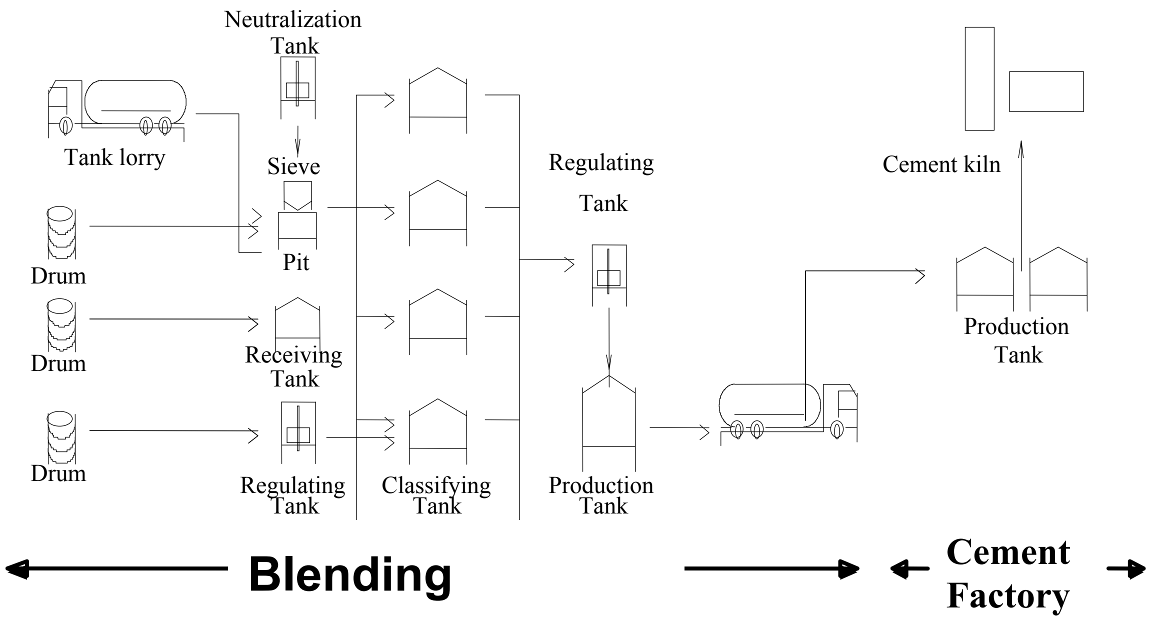
Source: Guidelines on Co-processing Waste Materials in Cement Production (GTZ- Holcim Ltd,) March 2005, Japan Cement Association

Figure 5-14: Types and feeding places of waste in the cement plant



Source: JICA Preparatory Study of "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus"

Figure 5-15: Type and feeding places of waste in the cement kiln (detail)



Source: JICA Preparatory Study of "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus"

Figure 5-16: Cement plant and blender of wastes

5.4.4 Strengthen Administration of Industrial Waste Management

The following measures will be taken to strengthen IW Administrative Capacity.

Measure 1. Strengthen organizational capacity of IW management

Measure 2. Improve management system of waste service companies (WSCs)

Measure 3. Strengthen regulations

Measure 4. Strengthen cooperation between administration, generators and waste service companies (WSCs)

a. Strengthen Organizational Capacity of IW Management

Although there is a sufficient legal and regulatory mechanism for industrial waste management at the federal level, the law enforcement capacity of the state government for industrial waste management is weak and limited, particularly in terms of available human resources. This section discusses the measures to strengthen organizational capacity of IPAAM and SUFRAMA for industrial waste management in the State of Amazonas.

a.1 Strengthening Organizational Capacity of IPAAM

In the State of Amazonas, the Environmental Monitoring and Management Section (GMAM) of IPAAM is responsible for IWM administration as a part of its duties as shown below:

- Environmental monitoring
- Performance evaluation of the activities with environmental licenses
- Implement response measures to remedy improper activities against the environment

The personnel responsible for this wide range of environmental management activities are: 3 chemists, 2 biologists, 1 civil engineer, 1 economist and 1 fishing expert. There is no personnel specifically assigned to industrial waste management. In this respect, IPAAM should undertake the following measures to improve the current IWM administration.

- Officially assign the officer responsible for IWM administration with the specified duties of registration, licensing and supervision of WSCs and waste inventory management and analysis.
- The IWM officer will collaborate with the IT engineer of the Information Analysis Management Section (GEAI) to develop the WSC Database (WSC_DB).
- The IWM officer will be responsible for handling the inquiries from WSCs concerning WSC registration/licensing, as well as the inquiries concerning the information on WSC available in the database.
- The IWM officer will also be responsible for issuing and revoking WSC license in collaboration with the GMAM monitoring officer and the other relevant officers in IPAAM
- In cooperation with SUFRAMA, the IWM officer will analyze the waste inventory database (WI_DB), which will be developed by SUFRAMA to identify the real time status of industrial waste management at PIM.
- The IWM officer will collaborate with the SUFRAMA officer in charge to improve and update the WI_DB and its guidelines.

a.2 Strengthening Organizational Capacity of SUFRAMA

SUFRAMA has formed an Industrial Waste Management Group (IWM Group) dedicated to industrial waste management at SUFRAMA and three SUFRAMA officers, who have been assigned as the counterpart members of this study since September 2009, joined the IWM Group. As of May 2010, it has not yet been decided to which department the group will be attached. It will be officially established within the fiscal year of 2010 to strengthen its IWM system.

At this moment, the waste inventories submitted by factories are managed by only one engineering officer belonging to the Division of Engineering and Architecture Projects Analysis Coordination (COPEA) of SUFRAMA. This officer is currently assigned to handle over 100 waste inventories from the factories while working on other tasks. Although he is trying his best to aggregate and analyze the enormous amount of waste inventory data, it is not possible to sufficiently comply with the duties provided in CONAMA Resolution 313.

SUFRAMA was requested by the Public Ministry of Amazonas State in 2001 to obtain an environmental license for the Industrial Districts, so it is essential to identify and analyze the current conditions of IWM in PIM. That is why SUFRMA requested the factories in PIM to submit waste inventories since before enforcing CONAMA Resolution 313.

Considering these conditions, SUFRAMA should take the following actions in collaboration with IPAAM to strengthen its organizational capacity of IWM.

- Officially establish the Industrial Waste Management Group (IWM Group) with official appointment of 3 staff members responsible for IWM in PIM.
- The IWM officers will work with the IT engineer in the information management group (CGMOI: Modernization and Informatics General Coordination) of the Administration Deputy Superintendence (SAD) to develop the waste inventory database (WI_DB).
- The IWM officers will be responsible for handling the inquiries from waste generators (factories) concerning the waste inventories and the information in the database.
- Working together with IPAAM in analyzing the data in the WI_DB, IWM officers will prepare a "PIM Industrial Waste Management Report" for submission to IBAMA and the State Public Ministry.
- The IWM officers, in collaboration with IPAAM, will encourage and guide PIM factories to submit waste inventories.
- The IWM officers, working closely with IPAAM, improve and update the WI_DB and its guidelines, as appropriate.

b. Improve Management System of Waste Service Companies (WSCs)

b.1 Improvement on the Categorization of Waste Management Service Licenses and Development of WSC Database

The fundamental method of properly supervising WSCs is to establish and strictly implement a licensing/registration system that clearly specifies the requirements for providing waste management services. However, due to the present WSC licensing/registration system's complicated categorization of waste management services over a variety of different fields, it is not useful for regulators (e.g. IPAAM and SUFRAMA) themselves or for WSCs; therefore it exists only in name and not fully in practice.

To improve this situation, the current licensing/registration system has to be integrated and simplified so that not only the regulators can easily manage it, but also so that the WSCs themselves, as well as the factories, can easily understand it. To do so, the study recommends a new integrated and simplified licensing system under the license categories shown in the table below.

Table 5-30: New Waste-related License Codes

Code	Main Category	Code	Sub-category	Classification (Types of Waste)
33	Municipal Waste Management	3301	Collection and Transportation	A (HW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3302	Intermediate Treatment	A (HW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3303	Reuse and Recycle	B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3304	Final Disposal	B (Non-HW & Non-Inert), C (Non-HW & Inert)
34	Industrial Waste Management	3401	Collection and Transportation	A (HIW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3402	Intermediate Treatment	A (HIW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3403	Reuse and Recycle	B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3404	Final Disposal	B (Non-HW & Non-Inert), C (Non-HW & Inert)

Under this new license system, WSCs are primarily categorized into 2 (two) categories, i.e. those who deal with municipal waste and industrial waste. Subsequently, they are further categorized into 4 types according to what types of waste services they provide, i.e. (1) collection and transportation, (2) intermediate treatment, (3) reuse and recycling and (4) final disposal. Furthermore, they are specified by the types of waste they handle, namely: A (HW), B (NON-HW, NON-INERT), and C (NON-HW, INERT). In applying for obtaining WSC licenses, the applicants are required to specify the waste management services they provide in accordance with this new category with the other required information while all such information will be immediately entered into the WSC database.

This new license categorization system is user-friendly for both regulators and applicants. The application procedure for WSC licensing will be simplified while the regulators can easily supervise the WSCs. Furthermore, for waste generators who are obligated to contract waste handling to licensed companies, it is easier to select the proper WSCs according to the type of wastes they handle and the type of work they are licensed to conduct.

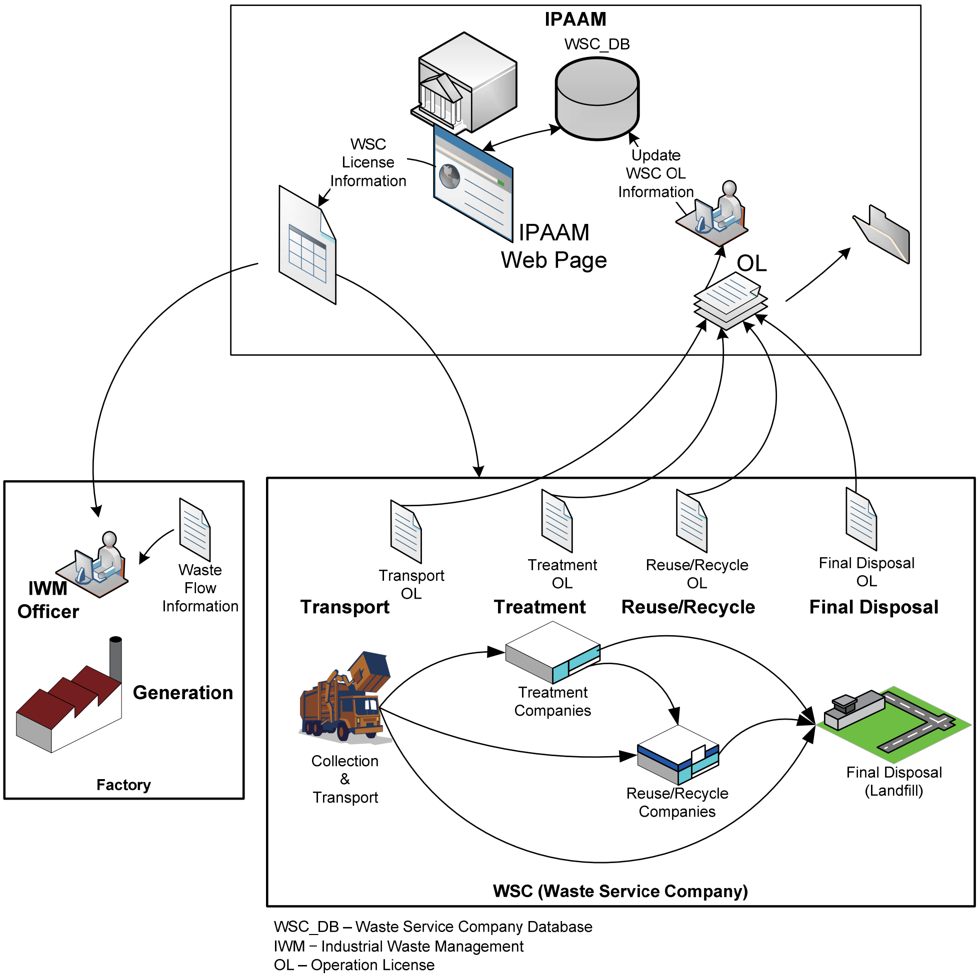


Figure 5-17: Waste Service Company Database (WSC-DB)

b.2 License Application and Licensing/Registration Procedure

The license application will be made in accordance with "the Guidelines for WSC License Application and Registration" (hereinafter, "Guidelines"), which is provided in the next Chapter. A set of uniform application forms will be prepared for use by WSCs. To simplify the application procedure, the application forms will be made available on the website in an editable, electronic document format so that the applicants can apply via the Internet.

In granting the WSC licenses, every application will be examined in accordance with the licensing criteria that will be specified by categories of services provided and types of wastes handled. Every applicant is required to submit the necessary information and data required by the criteria that will be available in the guidelines. In granting the licenses for intermediate treatment, reuse/recycling, and final disposal services, the conditions of relevant facilities and equipment have to be strictly examined to ensure that they have enough capabilities of providing the waste services they apply for licensing. In this respect, a facility and its operation standards should be determined for intermediate treatment, reuse and recycling, and final disposal of waste in accordance with the types of waste handled.

The regulators (IPAAM and SUFRAMA) are also required to monitor and supervise the activities of licensed WSCs by obligating them to submit annual activity reports, and conducting on-site inspection of their facilities.

b.3 Disclosure of the Information on Licensed WSCs to PIM Factories and Business Entities

The information about licensed WSCs will be made publicly available by uploading to the IPAAM website their key information, e.g. the company name, types of services provided, types of wastes handled and so forth so that the factories and business entities can select proper WSCs. SUFRAMA is also required to disclose this information actively to PIM factories to raise their awareness of the WSCs.

c. Strengthening Regulations

c.1 Overview

In order to properly manage industrial waste, the regulatory enforcement role of IPAAM is essential as the public entity primarily responsible for industrial waste management administration.

According to the relevant laws and regulations, IPAAM holds strong authority to control WSCs as well as waste generators including the factories in PIM in relation to industrial waste management, such as:

- Granting licenses for WSCs;
- Monitoring and supervising WSCs' compliance with license requirements;
- Expiration and/or revoking of the license and order of halting waste service operations in the case of non-compliance with the license requirements; and
- Issuance and expiration of environmental licenses of the factories in the case of non-compliance with the obligation to contract out industrial waste management to licensed WSCs.

By utilizing the existing legal/regulatory authorities and the new licensing/registration system for WSCs, IPAAM is able to further strengthen its direct law enforcement authority. However, more effective results will come from providing guidance and support to WSCs and factories so that both of them will voluntarily make their best efforts of proper industrial management.

c.2 Supervision of Waste Service Companies

c.2.1. Administrative Guidance and Strengthened Law Enforcement by IPAAM upon WSCs

IPAAM will promote license renewal of WSCs with the development of a complete WSC database while, in collaboration with SUFRAMA, confirming with PIM factories on whether they contract out industrial waste management to licensed WSCs through checking the waste inventory database. If they use non-licensed WSCs, IPAAM will instruct them to use licensed ones. Also, IPAAM must diligently keep the WSC database reliant through regular data entry and updating.

As for the licensed WSCs, IPAAM will investigate their service operations by the following measures, respectively:

- Operations of waste collection and transportation service companies will be reviewed at the time of license renewal, which will be determined in the new license system.
- Operations of intermediate treatment, reuse and recycling, and final disposal service companies will be reviewed annually based on the business operation report to be submitted by WSCs. On-site inspection will also be regularly carried out without prior notice to WSCs to confirm their proper service operations. In conducting on-site inspections, waste and final product samples from the treatment and recycling processes may be collected for laboratory analysis to investigate the compliance of WSCs with the relevant license requirements.
- When improper waste handling practices are discovered during the inspections, the actual conditions will be further investigated and provide specific instructions for corrective actions required in accordance with the license requirements.
- In case that IPAAM finds any illegal dumping or improper disposal activities by the reports from citizens or other information sources, it will immediately conduct site investigations. Once the perpetrator is identified, IPAAM will give administrative guidance or a restoration order. In the case that the perpetrator is a licensed WSC, strict administrative sanctions will be given to avoid any reoccurrence. In the case an offence is committed by a non-licensed company, they will be forced to halt their service operations. If it is a minor infraction, they will be encouraged to apply for licensing. But if it is a serious offence, the strict legal sanctions will be taken to strictly prohibit such activities.

c.2.2. Effective Utilization of License Renewal System for Assessment of the Operations of WSCs and Provision of Guidance

The current licensing/registration system requires WSCs to renew their licenses after a given period of time in order to continue operations. This license renewal system provides a good opportunity to review the operations of WSCs and provide guidance to them as needed.

Furthermore, it also provides that the license will be expired if the WSCs does not comply with the license requirements at the time of its renewal. Such a provision should be utilized to strictly control and correct waste management activities.

c.2.3. Establishment of Waste Acceptance Criteria by WSCs for Proper Screening of Waste before its treatment, reuse, recycling, and final disposal

The WSCs engaged in intermediate treatment, reuse and recycling and final disposal are advised to have their own waste acceptance criteria so that they can make contracts with those who bring wastes based on the compliance with these criteria. At the time of waste acceptance, they will visually confirm the types of waste or take some samples for laboratory analysis to check compliance with the criteria. In the event that the content does not comply with the criteria, they will ask those who bring the waste for corrective actions, or refuse waste acceptance if no change in their practices. It should be well understood by the WSCs that improper acceptance of waste leads to improper disposal of waste, which is a violation of licensing requirements for WSCs.

c.3 Supervision of Waste Generators (Ensuring the use of licensed WSCs)

When waste generators contract a third party to handle their industrial waste, they are obligated to contract it out to the licensed WSCs. In order for waste generators to select appropriate licensed WSCs, IPAAM will disclose the necessary information on licensed WSCs on its website. The necessary information includes company names, types of waste services, and the types of wastes they handle. SUFRAMA will also promote the use of this information by factories in PIM for proper industrial waste management by conducting public relations activities about the industrial waste management regulations in PIM areas.

To ensure that PIM factories contract with the licensed WSCs, SUFRAMA will require them to specify the name and license number of the WSCs they use throughout the entire waste stream, ranging from collection to final disposal, when submitting the waste inventory.

Strict implementation of this rule will reduce and eliminate the activities of non-licensed WSCs while encouraging their license applications.

d. Strengthen Coordination between Administration, Waste Dischargers and Waste Service Companies (WSC)

d.1 Promote Cooperation between Government Bodies

d.1.1. Establishing Collaborative Organizations

In order to achieve appropriate industrial waste management in the State of Amazonas, it is important to solve the issues concerning to various stakeholders. To do so IPAAM, which is directly responsible for industrial waste countermeasures, needs to form a close relationship with the many other concerned government organizations.

In order to do so, the Technical Sub-Committee, which meets during the Weekly Meetings of this study, will be reorganized to establish a permanent standing (tentatively named) Coordination Committee for Proper Industrial Waste Management Promotion (CCPIWMP) headed by SUFRAMA and IPAAM.

d.1.2. Participating Members

The members of the CCCPIWMP committee will include IPAAM (which manages industrial waste related companies), SUFRAMA (which manages PIM factories), SEMULSP (which manages the Manaus city landfill), the State Public Ministry which brings charges against improper waste disposal), FIEAM (the State industries federation), CIEAM (Industries Center of Amazonas State), and CCINB-AM (Japanese-Brazilian Chamber of Commerce and Industry of Amazonas), inviting other concerned organizations as necessary based on issues that arise.

It is advisable to also establish the group structure, such as the Chairperson of Facilitator when establishing the group, as well as regular reporting and meeting periods, and topics for deliberation, and so forth.

d.2 Promote Collaboration between Administration and Waste Generators

The efforts of waste generators can not be underestimated in order to achieve proper IWM. This involves a number of issues, such as requiring generators to contract industrial waste treatment and disposal only to licensed WSCs, the submission of waste inventories, and, as will be required hereafter, the use of waste manifests.

In order to achieve these things, it is important that the administration actively work with waste generators in the following ways.

- Administration should ask the generator to establish systems for comprehensive responsibility and technical management on IW in the factory.
- Administration should ask the generator to assign an IWM officer. The officer will be responsible to deal with overall factory waste management such as on-site waste

generation control and recycling, efforts to ensure waste separation and WSC contracting, and inventory reporting and use of a manifest.

- The administration will offer training and guidance to foster personnel that will work toward establishing these systems and offer information about advanced factories that are actively promoting proper treatment and disposal and the 3Rs.
- Also, conduct training and offer guidance in key areas such as how to prepare and use waste inventories and waste manifests.
- Administration should establish a committee, as detailed below, where IWM officers from different factories can discuss good management practices, and send a representative to facilitate the exchange of information and offer support concerning proper IWM practices.

d.3 Promote Collaboration between Administration and WSCs

A key point to proper IWM is to optimize WSC practices not only through regulation and administrative guidance but through proactively supporting companies toward the appropriate activities and working with them to eliminate non-licensed entities and correct improper treatment and disposal practices.

To do so, the administration must be proactive in working with licensed companies in the following ways.

- Once the new licensing system for WSCs is publicized, efforts must be made to establish this new system by educating and providing training on the new application procedures.
- Provide support to establish a technical management system for WSCs that will encourage reuse and recycling as well as proper treatment and disposal practices. To do so will require making information on these practices widely available as well as training personnel in these areas.
- By using the WSC database, it will be possible to clamp down on non-licensed companies. Furthermore, the business environment for WSCs will be greatly improved through making information on licensed companies widely available to generators (i.e. factories) in an easy-to-use format.

d.4 Strengthen Cooperation between Administration, Generators and WSCs

In addition to the collaboration between administration and generators or WSCs, it is advisable to create a Proper Industrial Waste Management Promotion Committee (PIWMPC, tentatively named) for discussion between the three sides led by the above-mentioned CCCPIWMP. Establishing such a committee that meets regularly will facilitate the exchange of information necessary for proper IWM and building consensus on various issues among members of the committee.

To encourage this collaborative relationship, it is advisable to create a group that represents the common interests of the waste service companies (WSCs). This will be difficult due to the present competitive atmosphere, but once a new system to support licensed companies is fully established, the administration should provide support for the establishment of an industry group for WSCs. In the future, such an industry group will voluntarily act on their own behalf to introduce measures for proper IWM and to develop their activities further.

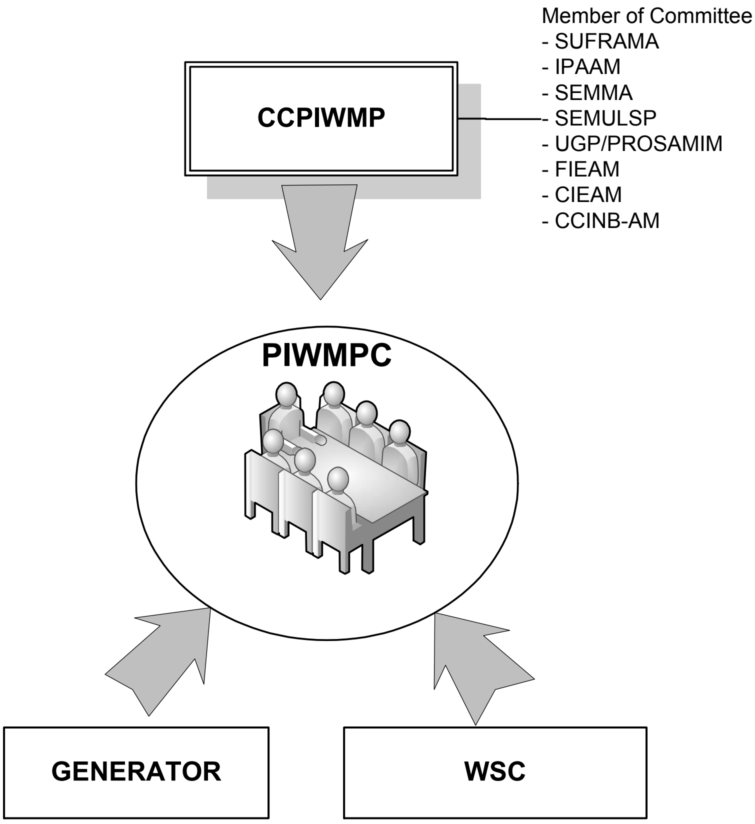


Figure 5-18: Relationship between the Coordination Committee for Proper IWM Promotion (CCPIWMP, tentative) and Proper IWM Promotion Committee (PIWMPC, tentative)

d.5 Vision for a New System of Treatment and Disposal

The world's manufacturing industry today is not only involved with the production of various products, but is working toward new changes or variations to their processes to reduce the amount and kinds of waste produced and trying to promote the 3Rs through the efficient use of waste as raw material or an efficient energy source. With a myriad of companies operating in PIM, as waste generators and WSCs improve their relations, they will be able to cooperate to construct a more intelligent system for treating waste as well as reuse and recycling. This presents new business opportunities. Particularly in the case of certain hazardous wastes, public-sector led initiatives could present more favorable conditions.

5.4.5 Improve Business Environment for WSCs

The following measures will be taken to improve the business environment to promote proper treatment and disposal of industrial waste.

Measure 1. Make Manaus municipal landfill fee-based

Measure 2. Regulate improper waste disposal

Measure 3. Publicize, educate and train generators and WSCs

Measure 4. Cultivate preferred WSCs

a. Make Manaus Municipal Landfill Fee-based

Industrial waste differs from municipal waste containing general waste from households in that it is generated through economic activity in pursuit of profits, and thus the treatment and disposal of industrial waste is fundamentally led by the polluter-pays-principal (PPP). However, in Manaus, even though the city landfill accepts a great deal of industrial waste, there is no fee charged for its disposal. This creates a number of problems which were found in this study, as outlined below.

- The on-site disposal rate is extremely low compared to that in other countries (4.2%[1] of the generation rate) and most waste is treated and disposed off-site. Much of that waste is brought to the Manaus City landfill.
- Despite the fact that the 3Rs are promoted as a national policy, the reuse and recycle rate in factories is only 1.6%[2] of the amount generated (of which, 1.4% is Non-HW and 2.1% is HW).
- The intermediate treatment facilities owned by WSCs use mostly used equipment and few environmental measures in order to drastically cut investment costs. Also, one private final disposal site was accepting waste without an environmental license and had to cease operations.
- Furthermore, cement factories are actively used for co-processing in other parts of Brazil, but almost not at all in the target study area.[3]

To encourage a reduction in the amount, or the reuse and recycling, of industrial waste generated, it is extremely important to introduce an incentive that will reduce treatment and disposal costs. There is an inherent cost to the proper treatment of industrial waste, but the cost burden lies with the waste generators, and this needs to be a basic condition for WSCs to operate. To do so, disposal of industrial waste brought to the Municipal landfill must be cost-effective, which requires the collection of a disposal fee needed to dispose of it properly. For this, IPAAM will have to cooperate with SUFRAMA to take the following measures.

- Make efforts to construct a dedicated landfill site for non-hazardous, non-inert industrial waste in Manaus.
- In order to bring about construction, work with the Amazonas State Public Ministry to form a TAC (Terms of Adjustment of Conduct) between the concerned parties and gain interim permission to operate a dedicated site for non-HW, non-inert IW.
- The City of Manaus must work to keep the management of the dedicated site for non-HW, non-inert IW separate from municipal waste, and collect the necessary fee to recover investment and operation costs.

b. Regulate Improper Waste Disposal

In order for WSCs in a healthy business environment to offer their services competitively, an environment must emerge in which they are able to charge an appropriate fee. First and foremost, there must be a transformation in thinking, namely amongst waste generators, regarding the need to pay for relative costs to properly treat and dispose of the waste they generate.

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[1] Bangkok Metro Area, Thailand: 35.0% (2002 Study); Mie Prefecture, Japan: 53.9% (2000 Study).
[2] Bangkok Metropolitan Area, Thailand: 13.1% Non-HW, 1.6% HW (2002 Study).
[3] Study Team estimates the waste utilization rate for cement production is only 0.84%, whereas in Japan it is 43.5%.

Meanwhile, it is essential to stamp out the flourishing practices of non-licensed waste service companies that are able to charge unreasonably low fees by cutting corners and undermining proper treatment and disposal, but also to monitor and direct licensed companies.

There are two types of non-licensed WSCs: those that never obtained a license at all, and those whose activities are outside that which they are licensed to perform. However, putting aside whether either of these is better than the other, such entities must recognize the need to obtain the proper license for their actual operations, and to do so, thereby resolving their non-licensed status.

It is essential for licensed companies to collaborate in uncovering improper treatment and disposal activities and bring it to the attention of authorities. Not only WSCs, but also factories must cooperate to ensure that the WSCs they contract are licensed and be diligent in tracking their waste to final destination through the use of the manifest system.

It will be possible to stamp out non-licensed companies and improper practices if factories ensure they are contracting licensed WSCs. Also, it is possible to prevent illegal dumping by clarifying the collection and transportation companies and ensuring they are licensed.

For companies engaged in intermediate treatment, reuse and recycling and final disposal, IPAAM will confirm that that their actual operations are in compliance with their licenses through annual reports and on-site inspections.

Meanwhile, treatment and disposal companies need to check and ensure that the wastes they receive from transportation companies are in accordance with the original contract based on their licenses.

If a company is discovered to be operating without a license, they must be immediately ordered to cease operations in accordance with the law, and assisted to obtain the proper license in the case of a minor infraction, or in the case of a serious offence, to cooperate with the proper authorities.

Should a licensed company be found to have conducted improper activities, after a thorough investigation of the facts, they will need to undertake actions to return conditions to their original state and carry out disposal in accordance with the law.

c. Publicize, educate and train generators and WSCs

Administration must collaborate with industrial groups and the person in charge of waste issues in the newly formed coordinating committee to educate, train and communicate with waste generators concerning the necessity of proper treatment and disposal, and also be sure they are aware of their responsibility for proper treatment and disposal as well as their responsibility to bear the corresponding costs. Administration must also collaborate with industrial groups to educate and train WSCs on proper operation practices and make sure they are aware of the necessity of proper treatment and disposal technology and their implementation.

Administration will support established industry groups for waste services to encourage voluntary activities such as publicizing and providing training for proper waste management.

d. Cultivate Preferred WSCs

Improvements to correct IWM are led by efforts to raise the level of waste service companies that are directly handling industrial waste. By cultivating preferred companies in that area, it effectively brings about improvement of the whole.

In order to encourage the emergence and cultivation of preferred companies, an effective policy, such as a system to promote preferred companies, will be introduced. This policy will select preferred companies as models which will raise the quality level of the overall industry of waste services. However, setting the selection requirements so high that the selection process becomes too complicated will not function as an incentive, so introduce incentives with the target in mind, such as advertising company names in a public venue or directly to waste generators or extending the validity of their licenses, or other preferential treatment measures.

Should conditions permit, such as having a firm licensing system in place or a reliable industry group, it may be effective to introduce a rating system, such as that used in Iwate Prefecture, Japan (see "Good Practice" in Chapter 6).

5.5 Project Evaluation

5.5.1 Implementation Plan

The implementation plan for the Master Plan (M/P) formulated in this study is summarized in the table at the end of this section.

SUFRAMA and IPAAM, as the counterpart organizations of this study which will implement the M/P, will consign the technical system of industrial waste management, namely the provision of facilities and equipment needed for treatment and disposal, to private interests. Accordingly, the M/P notes the appropriate components for the technical system to be provided by the private sector and puts the management system of the administration at the heart of providing guidance to correctly manage its operation and maintenance.

Based on this basic idea of the M/P, the implementation plan gives preference to the provision of the administration's management system. Furthermore, in this study, the following tools, which are seen as essential to develop the management system, were developed by the end of May 2010 and transferred to the appropriate organization:

- Development of a Waste Service Company Database (WSC_DB) as a tool to organize and manage waste service companies, as well as WSC_DB operation guidelines.
- Development of a Waste Inventory Database (WI_DB) to grasp the actual conditions of industrial waste management at generation sources (factories), as well as WI_DB operation guidelines.

Therefore, the first step of preparing the administration's management system has already begun. Furthermore, other parts of the M/P have also been initiated already. Moreover, particular issues which will require extra attention in the implementation plan (as shown in the figure below) are outlined, taking into consideration progress that has been made already in some areas.

a. (A) Understand Actual Treatment and Disposal of Industrial Waste

a.1 Measure 1) Establish Waste Manifest System

IPAAM will deal with the following based on the recommendations for the M/P

- Establish a standard format and system for the waste manifest in Amazonas State by the end of the year 2010.

- Plan the development of the online waste manifest, making use of the PROSAMIM budget. With that, the online waste manifest system is to be developed in the year 2011.

a.2 Measure 2) Report Location of Final Destination

As above, after a waste manifest system (WMS) for Amazonas State is formulated in 2010, the new system will make it possible to verify the site of final destination in 2011.

a.3 Measure 3) Obtain Complete Records of Submitted Waste Inventories

A trial test of the WI_DB system was conducted in May 2010. Based on the results of this trial, IPAAM will work with SUFRAMA to improve the WI_DB system and users guide from early 2011 and finalize them. Then, all PIM factories will be asked to make their waste inventories according to the WI_DB system and be submitted.

b. (B) Secure Industrial Waste Final Destination

b.1 Measure 1) Move Forward with Construction of New Industrial Waste Landfill

In relation to the introduction of a fee-based system at Manaus City Landfill, In January 2010 the Municipality of Manaus established the Municipal Law on Urban Cleansing Services (No. 1411, January 20, 2010). This law makes it possible to charge a higher fee for most industrial wastes than for municipal waste[1]. Consequently, this prepares the conditions for private companies to invest in the construction of a new industrial waste landfill.

According to IPAAM, the environmental study for non-hazardous (Class II) waste has been completed and private companies are now preparing to hold a public hearing. Therefore, this implementation plan calls for the new industrial landfill plans to be approved in 2011, complete construction in 2012 and begin operations in 2013.

b.2 Measure 2) Implement Provisional Measures until New Landfill is Operational

b.2.1. Measure 2.1) Use of Manaus Municipal Landfill

According to IPAAM, at the end of June 2010, a committee was established comprised of IPAAM, SEMMA, the Municipal Urbanization Department of Manaus, the Airport Authority, and others, to consider the possibility of constructing a dedicated section for non-hazardous, non-inert industrial waste (ATRINI). ATRINI will be constructed based on the decision of this committee.

The plan shows that ATRINI would begin operations in mid-2011, and once the private landfill mentioned above begins operations, ATRINI would be closed in early 2013. It will be necessary to rectify these plans as fit according to their respective progress.

b.2.2. Measure 2.2) Promote Appropriate Treatment of Hazardous Waste

The measures to appropriately treat hazardous wastes were formulated by the study team with the support of the C/P, taking into consideration current conditions of treating industrial waste in Manaus. Based on these measures, IPAAM will formulate a plan for the appropriate

[1] This is an impressively large law containing 198 provisions and is primarily concerned with the overall municipal cleansing services. The specifics of these provisions will take time before they are finalized, but it has been decided that a fee-based system will be introduced for the collection and disposal services of municipal waste. Furthermore, some wastes will be designated not as municipal waste but as large volume or special waste: 50 liters or more per day of non-hazardous, inert (Class 2-B) waste, 200 liters/day or more of non-hazardous non-inert (Class 2-A) waste, and hazardous (Class I) waste. In those cases, a city-approved waste service company will be able to charge a higher fee than for municipal waste.

treatment of hazardous wastes with special attention to current conditions. However, to implement the plan, first IPAAM must enforce the waste service companies (WSC) licensing management system and ensure that all WSCs obtain the proper license, therefore bringing sufficient transparency to what services are actually being performed.

b.2.3. Measure 2.3) Promote Co-processing

The process to promote co-processing is similar to the promotion of appropriate treatment of hazardous waste, above.

c. Strengthen Administration of Industrial Waste Management

c.1 Measure 1) Strengthen Industrial Waste Management Organizations

Measures to strengthen IPAAM and SUFRMA, the main organizations managing industrial waste, is already underway, to be completed in 2010.

c.2 Measure 2) Improve Management System of Waste Service Companies

The most important item to improve the management system of waste service companies is to firmly establish the system to register WSCs. This is best done as soon as possible, but the State Legislature will vote in October 2010, so the plan calls for this system to be established sometime in 2011. Once the system is in place, the WSC_DB will be constructed immediately and certain information about the licensed companies will be made public.

c.3 Measure 3) Strengthen Regulations

Once the information on WSCs is made public, IPAAM will put regulations in place to deal with non-licensed companies, as well as licensed companies which carry out improper waste disposal. Furthermore, IPAAM will work with SUFRAMA, FIEAM and others to regulate waste generators against outsourcing to non-licensed companies.

c.4 Measure 4) Strengthen Cooperation between Administration, Generators and Waste Service Companies

The measures recommended by the Study Team to strengthen cooperation between administration, generators and WSCs were formulated with the counterpart, taking into consideration the current conditions in Manaus. Based on this policy, IPAAM will discuss with related organizations the need to establish (1) a Coordination Committee for Proper Industrial Waste Management Promotion and (2) a Proper Industrial Waste Management Promotion Committee sometime in 2011 to act as the center for these relations.

d. Improve Business Environment for Waste Service Companies

d.1 Measure 1) Make Manaus Municipal Landfill Fee-based

As mentioned above, based on the Municipal Law on Urban Cleansing Services, the Municipality of Manaus is currently deciding the details supporting the provisions, establishing a city landfill fee, and selecting collection and disposal services for large volume and special wastes which will be treated as industrial waste. It is assumed that these decisions will be completed in 2010 and that the municipal landfill can introduce a fee-based system in 2011. It will be necessary to rectify these plans as necessary based on the progress of other plans, such as the construction of ATRINI.

d.2 Measure 2) Regulate Improper Waste Disposal

Until improper waste disposal is sufficiently regulated, both waste generators and waste service companies will need to be informed and instructed on the necessity for proper disposal and the details of the WSC licensing management system. On that basis, improper waste disposal will be regulated.

d.3 Measure 3) Inform, Educate and Train Generators and WSCs

IPAAM will need to develop itself as an organization to inform, educate and train generators and WSCs on industrial waste management. On that basis, they will formulate a plan to carry out these tasks and develop the information, education and training tools needed, and then carry out the plan.

d.4 Measure 4) Cultivate Preferred Waste Service Companies

The first step to cultivate preferred waste service companies is to properly understand the good examples of waste management which currently exist in Brazil. On that basis, a plan to cultivate preferred WSCs will be formulated and carried out. When formulating the plan, consideration should be given to the good examples from Brazil and Japan introduced during the study.

Table 5-31: Implementation Plan

Notation	Implementation Plan	Activities	Executing Organization
A. Understand Actual Treatment and Disposal of Industrial Waste			
A1	Establish Waste Manifest System	Establish a standard format and system	IPAAM
		Implement new waste manifest system (WMS)	IPAAM
		Develop online WMS	IPAAM, INEA, etc.
		Implement online WMS	IPAAM, INEA, etc.
A2	Report Location of Final Destination	Verify final destination through the operation licenses (OL) of generato	IPAAM, Generators
		Verify final destination through OL of WSCs	IPAAM, WSC
		Verify final desination through new WMS	IPAAM
A3	Obtain Complete Records of Submitted Waste Inventories	Develop the Waste Inventory Database (WI_DB) system	JICA Study Team, C/P
		Test the WI_DB system	IPAAM, SUFRAMA
		Improve and finalize the WI_DB system and users guide	IPAAM, SUFRAMA
		Full implementation of the WI_DB system	IPAAM
		Understand conditions of IWM for the State, and make report	IPAAM, SUFRAMA
		Formulate State waste management plan	IPAAM
B. Secure Industrial Waste Final Destination			
B1	Move Forward with Construction of New Industrial Waste Landfill	Explore introduction of fee-based system at Manaus Municipal landfill	Municipality of Manaus
		Introduce fee-based system at Manaus Municipal landfill	Municipality of Manaus
		Explore options to assist in the contruction of new landfill	SUFRAMA, IPAAM, etc
		Establish measures to prevent improper disposal and illegal dumping	IPAAM
		Plan the new industrial waste landfill	Private Enterprise, IPAAM
		Construct the new industrial waste landfill	Private Enterprise
		Operate new landfill	Private Enterprise
B2 Implement Provisional Measures until New Landfill is Operational			
B2.1	Use of Manaus Municipal Landfill	Plan section for non-hazardous non-inert industrial waste (ATRINI)	Municipality of Manaus, IPAAM, etc.
		Construct ATRINI	Municipality of Manaus
		Operate ATRINI	Municipality of Manaus
B2.2	Promote Appropriate Treatment of Hazardous Waste	Formulate policy for appropriate treatment of hazardous wastes	JICA Study Team, IPAAM
		Formulate plan to promote appropriate treatment of hazardous wastes	IPAAM
		Implement plan to promote appropriate treatment of hazardous wastes	IPAAM
B2.3	Promote Co-processing	Formulate policy to promote co-processing	JICA Study Team, SUFRAMA, IPAAM
		Formulate plan to promote co-processing	IPAAM
		Implement co-processing promotion plan	IPAAM
C. Strengthen Industrial Waste Management System of Waste Service Companies (WSC)			
C1	Strengthen Industrial Waste Management Organizations	Formulate policy to strengthen IWM organizations	JICA Study Team, IPAAM, SUFRAMA
		Strengthen IPAAM's system for IWM	IPAAM
		Strengthen SUFRAMA's system for IWM	SUFRAMA
		Enforce industrial waste management	IPAAM, SUFRAMA, etc.
C2	Improve Management System of Waste Service Companies	Develop WSC licensing management system and database (WSC_DB)	JICA Study Team, IPAAM
		Establish WSC licensing management system	IPAAM, etc.
		Implement WSC licensing management system	IPAAM
		Construct WSC_DB and publicize WSC information	IPAAM
C3	Strengthen Regulations	Regulate improper disposal activities by licensed/non-licensed WSCs	IPAAM
		Regulate against outsourcing to non-licensed companies	IPAAM, SUFRAMA, FIEAM
C4	Strengthen Cooperation between Administration(A), Generators(G) and Waste Service Companies(WSC)	Formulate policy to strengthen cooperation between A, G and WSCs	JICA Study Team, IPAAM
		Establish Coordination Committee for Proper IWM Promotion	IPAAM, SUFRAMA, FIEAM, etc.
		Establish Proper IWM Promotion Committee	IPAAM, SUFRAMA, FIEAM, Factories,WSC, etc.
		Implement policy to strengthen coordination between A, G and WSCs	IPAAM, SUFRAMA, FIEAM, Factories, WSC, etc.
D. Improve Business Environment for Waste Service Companies			
D1	Make Manaus Municipal Landfill Fee-based	Make preparations to introduce fee at Manaus Municipal landfill	Municipality of Manaus
		Make Manaus Municipal landfill fee-based	Municipality of Manaus, etc.
D2	Regulate Improper Waste Disposal	Inform and educate waste generators	IPAAM, SUFRAMA
		Inform and educate waste service companies	IPAAM
		Strict oversight of improper disposal by licensed/non-licensed WSCs	IPAAM
D3	Inform, Educate and Train Generators and WSCs	Strengthen IPAAM's IWM system	IPAAM
		Formulate plan to inform, educate & train generators and WSCs	IPAAM
		Implement plan to inform, educate & train generators and WSCs	IPAAM
D4	Cultivate Preferred Waste Service Companies	Study the good examples of advanced States	JICA Study Team, IPAAM
		Formulate plan to cultivate preferred WSCs	IPAAM
		Implement plan to cultivate preferred WSCs	IPAAM

Year: 2010, 2011, 2012, 2013, 2014, 2015

Key
- Plan and development of facilities, systems, etc.
- Operation or execution of facilities, systems, etc.
- Construction plan for disposal site (assumed)

5.5.2 Project Evaluation

The following section is analysis of the results expected with the implementation of the Master Plan (M/P).

a. Expansion of the Market for Industrial Waste Treatment

At present, the majority of industrial waste generated at factories and businesses located in the "Industrial Pole of Manaus (PIM)" is disposed of in a landfill free of charge. Such conditions do not leave much room for industrial waste treatment /disposal businesses to be introduced.

According to the results of this study, it is estimated that industrial waste from 230,000 tons per year, or approximately 629 tons per day, of industrial waste are generated from PIM in 2009. The following table shows the present conditions of treatment and disposal of PIM industrial waste as estimated based on the factory survey results.

Table 5-32: Conditions of Treatment and Disposal of PIM Industrial Waste (2009)

Item	Non-HIW		HIW		All Industrial Waste	
	Amount (Ton/day)	%	Amount (Ton/day)	%	Amount (Ton/day)	%
Generation Amount	509.0	-	119.9	-	628.9	-
On-site Treatment and Disposal	22.2	4.4	4.2	3.5	26.4	4.2
Reuse/Recycle	6.4	1.3	2.5	2.1	8.9	1.4
On-site Storage	2.8	0.6	0.4	0.3	3.2	0.5
On-site Disposal	13.0	2.6	1.3	1.1	14.3	2.3
Off-site Treatment and Disposal	486.8	95.6	115.7	96.5	602.5	95.8
Reuse/Recycle by Contractor	200.2	39.3	20.0	16.7	220.2	35.0
Intermediate Treatment by Contractor	175.4	34.5	71.1	59.3	246.5	39.2
Direct disposal of at landfill	111.2	21.8	24.6	20.5	135.8	21.6

This table shows that at least 135.8 tons/day, or approximately 50,000 tons/year, accounting for some 21.6% of the industrial waste generated, is brought to the landfill untreated. Also, in addition to this, there is believed to be a significant amount of untreated waste or the residues from reuse /recycling and intermediate treatment contractors or other companies that end up in the landfill.

Moreover, assuming these conditions continue, the Master Plan formulated in this study estimates the following generation, treatment and disposal amounts for PIM industrial waste in the year 2015.

Table 5-33: Amount of PIM IW Generated, Treated and Disposed of in 2015

Item	Non-HIW		HIW		All Industrial Waste	
	Amount (ton/Day)	%	Amount (ton/Day)	%	Amount (ton/Day)	%
Generation Amount	628.2	-	157.5	-	785.7	-
On-site Treatment and Disposal	26.2	4.2	5.4	3.4	31.6	4.0
Reuse/Recycle	8.1	1.3	3.8	2.4	11.9	1.5
On-site Storage	2.9	0.5	0.4	0.3	3.3	0.4
On-site Disposal	15.2	2.4	1.2	0.8	16.4	2.1
Off-site Treatment and Disposal	602.0	95.8	152.1	96.6	754.1	96.0
Reuse/Recycle by Contractor	238.3	37.9	29.6	18.8	267.9	34.1
Intermediate Treatment by Contractor	227.8	36.3	94.5	60.0	322.3	41.0
Direct disposal of at landfill	135.9	21.6	28.0	17.8	163.9	20.9

Based on the results of future estimation, the amount of industrial waste taken to the landfill in 2015 will be approximately 163.9 ton/day, or about 60,000 ton/year.

Meanwhile, the M/P proposes that Non-HIW & Non-inert IW is no longer brought to the landfill for municipal waste. Also, it proposes that HIW is reduced or detoxified through intermediate treatment, such as co-processing, or through reuse /recycling and intermediate treatment, and the residues disposed of at Non-HIW & Non-inert IW landfill.

The M/P aims to build a system of appropriate regulation and management for IW treatment and disposal, as is currently implemented in advanced states such as Sao Paulo, and in addition to that, to cultivate waste service companies that will carry out appropriate treatment and disposal of industrial wastes.

With that, the following table is an estimate of the industrial waste final disposal market in PIM in 2015, based on the current final disposal fees (not including collection and transportation costs) for Non-HIW and HIW at the industrial waste landfill in Sao Paulo State (not including intermediate treatment).

Table 5-34: PIM 2015 Market Scale for IW Disposal

	Amount (ton/Day)	Annual Disposal (ton/Year)	Disposal Fee (Real/ton)	Total Market Size (Based on Fee) (Real/Year)
Non-HIW	135.9	49,603.5	100[*1]	4,960,350
HIW	28.0	10,220.0	250[*2]	2,555,000
Total Industrial Wastes	163.9	59,823.5	-	7,515,350

[*1] 100 Real/ton is the median disposal fee of 80 – 120 Real/ton charged for Non-HIW in Sao Paulo State.
[*2] 250 Real/ton is applied for the HIW disposal fee in Sao Paulo State.

The market scale for industrial waste disposal in the Industrial Pole of Manaus in 2015, based on fees, is estimated to be about 7.5 million Real per year.

Actually, it is also possible that part of industrial waste (e.g. Residues from treatment) currently contracted to reuse/recycling companies and intermediate treatment companies could be taken to the new landfill (which is 215,423 tons/year, about 3.6 times the 59,824 tons/year of landfill waste), if management and regulation for the proper treatment and disposal of industrial waste are strengthened, and companies conducting improper activities are eliminated through careful implementation of the M/P.

b. Expansion of Potential to Attract "High Value-Added Industry" and "Export Industry" to the Industrial Pole of Manaus through Appropriate Industrial Waste Management System and the Provision of Infrastructure for Treatment and Disposal

In order for the Industrial Pole of Manaus to be an important center of economical and industrial activity that supports the social and economic development of the Amazonas State, it must produce higher economic profits by providing industrial infrastructure that can attract "high value-added industries" such as high-tech/IT equipment, and form connections to the international market by attracting the "export industry".

The high value-added "high-tech/IT industry", symbolized by the semiconductor industry, uses a number of chemical substances and rare metals in its manufacturing process and produces wastes in the form of waste oil, solvents and sludge, which includes materials containing hazardous properties. Thus, there is the possibility that preparing the environmental infrastructure to properly treat and disposal of these types of wastes is an important condition in factory location for these high-tech industries.

The exporting industry, which targets the international market, particularly in industries targeting export to advanced countries in the OECD, contains strict environmental policy obligations based on bilateral free trade agreements, ISO14001 and so forth for the production and manufacturing processes, which includes the proper treatment and disposal of wastes. In these exporting industries, since locating a factory in a region that does not guarantee the proper treatment and disposal of industrial waste is a huge risk, it is a critical requirement for those who hope to attract these industries to prepare a proper waste management system and the infrastructure for treatment and disposal.

This point was considered in the M/P formulated in this study by promoting a proper industrial waste management system and provisions for treatment and disposal infrastructure in PIM. This will contribute to greatly increasing the potential to attract industry with greater economic profit.

c. Improvement of Production Efficiency through Waste Reduction Efforts (Efficiency of Resource and Energy Usage)

Implementing the M/P and reinforcing industrial waste management, waste generators, starting with factories, will have to bear an additional cost for the proper treatment and disposal of waste to act in accordance with standards prescribed in the regulations. In Manaus, where the current cost burden is zero, it may be possible to implement a burden of 100 – 250 Real per ton as currently charged in Sao Paulo City. To do so, it is likely that waste generators will have to be strongly motivated to reduce or minimize their wastes as much as possible.

However, reducing or minimizing wastes produces the merits of raising material and energy efficiency in the manufacturing process, improving production and reducing costs, so they may make the efforts to this effect. Furthermore, it is possible to establish a stable operation foundation that can withstand price fluctuations in materials and energy, and changes in product demand.

As the M/P recommends, if the factories and businesses located in PIM are strongly motivated to control the generation of waste, this could lead to opportunities to increase factory production. In this regard, as was historically proven in Japan in the past, when the country's industries improved their production efficiency and reduced production costs, it was able to surpass the critical risk factors such as rising oil prices and currency appreciation.

As one of the BRIC emerging economies, Brazil is expected to lead the world's economic future and form a powerful industrial infrastructure based on resource and energy efficiency on par with the developed countries, which is essential to ensure sustainable future development.

6. Guidelines to Improve Industrial Waste Management in PIM

6 Guidelines to Improve Industrial Waste Management in PIM

6.1 Guideline Objectives and Composition

6.1.1 Guideline Objectives

The aim of the guidelines is to support the Master Plan objective to "establish an appropriate industrial waste management system in the Industrial Pole of Manaus (PIM)". To achieve this objective, the guidelines shall serve to achieve the following three requirements.

1. To establish an appropriate management system at generation sources (such as factories) for dischargers of industrial waste.
2. To establish an appropriate management system for industrial waste that has been discharged for waste service companies.
3. To establish the administrative system for industrial waste management to promote, guide, monitor and regulate proper management for dischargers of industrial waste and waste service companies.

6.1.2 Composition of the Guidelines

The following three items in the Master Plan (see previous chapter) shall be used to the greatest extent possible as tools to achieve the objectives of the above-mentioned guidelines.

1. Waste inventory (WI) management system
2. Waste service company licensing and registration management system
3. Waste manifest system

These guidelines are meant to promote the improvement of industrial waste management through the effective use of these tools by waste dischargers, waste service companies (WSC) and administration. The guidelines are composed as shown below:

1. Items common to the three tools
2. Guidelines for waste dischargers
3. Guidelines for WSCs
4. Guidelines for administrative entities

These guidelines were formulated for the PIM factories that discharge industrial waste in the target study area, the waste service companies (WSCs) which handle the discharged waste, and the administration that handles overall industrial waste management. However, they were created as much as possible so that they may serve as reference material for other industrial complexes or areas where factories are concentrated. Accordingly, stakeholder organizations such as SUFRAMA or the Ministry of Environment, are expected to share these results with related organizations, such as industrial groups and so forth, nationwide.

6.2 Common Items

The key in putting the three systems--for waste inventory (WI) management, WSC registration management, and waste manifest--to use is that each of these systems uses common code and units of measurement. This section discusses the importance of each system utilize these common items.

6.2.1 Waste Definition and Categorization of Wastes and How to Determine Them

In each of the three systems, industrial waste is divided into three major categories, based on CONAMA Resolution 313.

- General industrial waste
- Health-care waste
- Construction waste

How each of the wastes are defined and categorized, as well as the methods to determine these ends, is discussed below.

a. General industrial waste

General industrial waste is defined as all waste generated in a factory, including administrative and production units, but excluding health-care waste and construction waste (see below). This category will use both the waste category set forth in CONAMA Resolution 314 (hereafter, CONAMA code) and the waste code created by JICA Study Team through the discussion and approval with IPAAM/SUFRAMA (hereafter, JICA Study code).

The conventional CONAMA code categorizes wastes in great detail based on the chemical composition and physical properties. However, the code is overly detailed for practical application, particularly for IPAAM/SUFRAMA to manage waste based on the actual industrial waste management flow. In order to identify the general industrial waste flow according to the waste the JICA Study Team set up the Study code that has 29 categories, with 13 types of Non-HIW, and 16 types of HIW and identify the industrial waste flows of 29 categories of general IWs. In addition the JICA Study Team has prepared a chart comparing both CONAMA and JICA codes so that it will be easy to enter the waste code.

The wastes categories are shown in the table below.

Table 6-1: Non-Hazardous General Industrial Waste Categories used in the Study

Type of Non-HIW	Non-HIW Code
Kitchen waste (include waste from animal such as bone, skin, hair)	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Animal oil, Vegetable oil	NH06
Rubbers and Leather	NH07
Ash/dust from coal-fired power plants, etc.	NH08
Metals and metal alloys such as aluminum, copper, bronze	NH09
Ceramic & Glasses	NH10
Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH11

Mixed waste (This code shall be applied in case wastes are discharged without separation.)	NH12
Others	NH13

Source: JICA Study Team

Table 6-2: Hazardous General Industrial Waste Categories used in the Study

Type of HIW	HIW Code	Example of HIW
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic Compounds	HW04	including Hg, As, Cd, Pb, Cr, CN
Inorganic Compounds	HW05	Plating wastes, Picking waste, Sulphides, etc.
Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.
Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge	HW11	Inorganic sludge, Organic sludge, Septic tank sludge, etc.
Ash from incinerator	HW12	---
Dust and Air pollution control (APC) products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above
Mixed Waste	HW15	---
Hazardous materials from Non-production process	HW16	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.

Source: JICA Study Team

b. Health-care Waste

Health-care waste is defined as waste generated from clinics attached to factories. This category uses the groups set forth in ROC 306/2004-ANVISA. It is not necessary for factories that do not have attached clinics to answer this section.

The health-care waste category is shown in the table below.

Table 6-3: Conversion of Health-care Waste Categories between RDC 306/2004-ANVISA and ABNT NBR 12809

RDC 306/2004-ANVISA			**ABNT NBR 12809**	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

c. Construction Waste

Construction waste is defined as waste that was generated from construction at factories (from all departments, including administration and production) in the past one year. This code utilizes the classes set forth in CONAMA Resolution 307.

The Construction wastes category is shown in the table below.

Table 6-4: Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A:	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton, metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. *(new text given by Resolution n. 348/04)*.

6.2.2 Non-IW Common Items

a. Factory Categorization Code

The factory categories utilize the categorization SUFRAMA uses for registered factories.

SUFRAMA uses 19 factory codes, and further subdivides 4 of the factory codes for a total of 28. However, only the large factories included in Part 1 of the SUFRAMA factory list use the sub-categories, so only the 19 primary categories are used for industrial waste management, such as when creating the waste flowcharts.

The Factory categorization code has been attached at the front of this report for the reader's reference.

b. Waste Service Company Categorization Code

IPAAM plans to use a new environmental license code dedicated only for waste service companies (WSC). There are two main categories depending on the type of waste the WSC handles: "Municipal Waste (code 33xx)" and "Industrial Waste (code 34xx)", which are then subdivided into categories for collection/transportation, intermediate treatment, reuse/recycling, and final disposal. These codes are given in the table below.

If a company conducts more than one type of service, it must be licensed and registered under all of the appropriate codes. For example, if a company collects and transports industrial waste and also recycles it, then it will have to be registered under both code 3401 and 3403.

Table 6-5: Waste Service Company Categorization Codes (Draft)

Code	Major Classification	Code	Sub-classification	Class [types of Waste Handled]
33	Municipal Waste Management	3301	Collection and Transportation	A(HW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3302	Intermediate treatment	A(HW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3303	Reuse/Recycling	B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3304	Final disposal	B(Non-HW & Non-Inert), C(Non-HW & Inert)
34	Industrial Waste Management	3401	Collection and Transportation	A(HIW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3402	Intermediate treatment	A(HIW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3403	Reuse/Recycling	B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3404	Final disposal	B(Non-HW & Non-Inert), C(Non-HW & Inert)

c. Units of Measurement

The amount of general industrial waste, health-care waste and construction waste generated in PIM is indicated in weight (tons) as a unit of measurement, which also served to create the PIM waste flow. Waste generated by volume or individually is to be converted to indicate weight before being entered. Also, in cases where the generation amount is extremely small, such as for health-care waste, it can be indicated in kilograms (kg) instead of tons.

(Note: measure by apparent density as a simple conversion method from volume (m^3) to weight (ton))

(1) Things to prepare

- Sample (when weight is unknown)
- Plastic bucket (about 20 litres)
- Scale (max. approx. 50kg)

(2) Measure the weight of the plastic bucket (Basket weight (Bw): kg)

(3) Measure the weight of the plastic bucket with 10 liters of water (the water ratio is 1.0 so this is 10kg).

(4) Mark the water line of 10 liters of water in the bucket.

(5) Pour out the water and pack the sample into the bucket up to the line. (Gwb (kg) = Bw + Weight of 10 liter sample)

(6) The sample's apparent density AM (ton/m^3) is calculated with the following formula.

$$AM\ (ton\ /\ m3) = \frac{(Gwb - Bw)}{10}$$

(7) Sample weight conversion: Multiply the known volume of the sample by AM and calculate the weight.

d. Other

The databases for the waste inventory management system (WI_DB), waste service company licensing and registry management system (WSC_DB), and waste manifest system (WMS) are all managed using the National Corporate Tax Payer registration number (CNPJ) as their "Primary key" so that all the databases can be linked. Consequently, the format of the CNPJ to be entered will be the officially registered CNPJ. If this is done online, a program will confirm the number entered according to the following format.

CNPJ Format: XX.XXX.XXX/0001-1

6.3 Waste Management Improvement Guidelines for Waste Dischargers (Factories)

6.3.1 Requirements for Making the Waste Inventory

a. Waste Flow

Understanding the waste flow is important in order to conduct appropriate industrial waste management. The waste flow is made up of waste management (treatment /disposal) at the generation source (on-site) and waste management (treatment /disposal) by WSCs (off-site). A conceptual diagram of this waste flow is shown in the figure below.

This study attempted to gauge the waste flow in all of PIM by conducting a factory survey for on-site management (treatment /disposal), and a survey of WSCs for off-site management (treatment /disposal). These results were analyzed and the outcome was used to make an overview of the waste flow. However, information concerning waste discharged from factories varied and some WSCs were unaware of the accurate figures, so there was some ambiguity in the flow between on-site and off-site.

Information about to whom the waste was discharged and how it would be treated and disposed is to be included on the waste inventory, but there is no uniform standard between companies; with only one person in SUFRAMA managing the waste inventories, it is not possible to aggregate the information.

IPAAM/SUFRAMA has created a standard waste inventory which will be filled out in a uniform manner, which will then be integrated into a database. By doing so, it will be possible to make effective use of this information to manage industrial waste in the future.

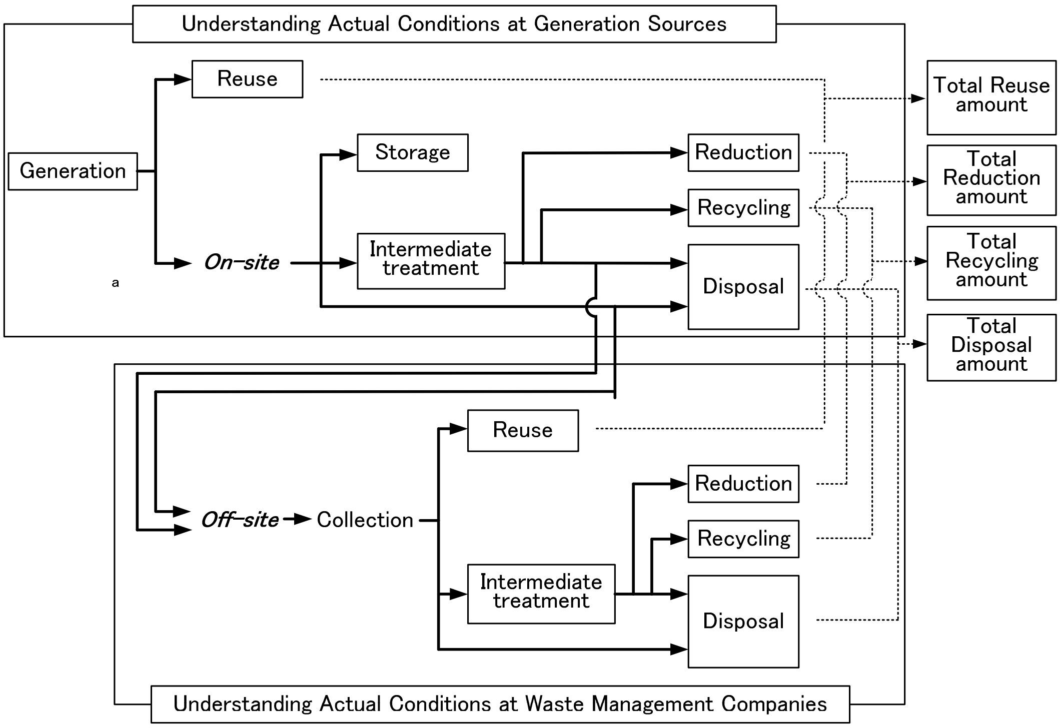


Figure 6-1: Flow of Waste Treatment and Disposal

b. Summary of On-site Waste Management

CONAMA Resolution 313 calls for highly detailed factory information to be included on the waste inventory. The CONAMA Resolution 313 scheme is shown in the following figure.

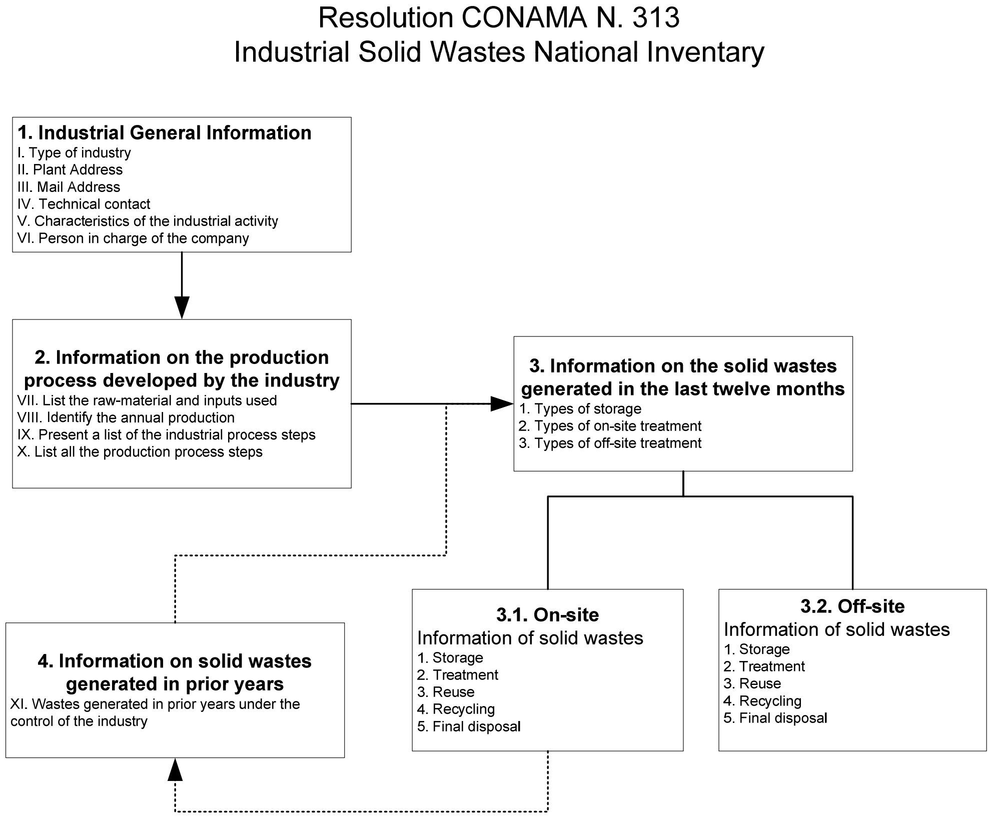


Figure 6-2: Scheme of the Information required by CONAMA resolution 313

It is possible to gauge the overall on-site management of waste by aggregating and analyzing this waste inventory information. However, because only 1/4 of factories submit the WI and the variation in the manner in which those received are filled out, there is no way at present to easily aggregate and make use of the data.

This guideline provides detailed instructions to filling out the information necessary for the WI and makes it possible for the factories to report using a single format. The detailed instructions called for in CONAMA Resolution 313 are given in the Chapter 5.2.1 of the Supporting report.

c. Summary of Off-site Waste Management

The waste inventory also requires off-site treatment and disposal to be reported. However, the number of WSCs and what activities they are engaged in are uncear, so this can not be accurately filled in. This guideline also provides information on the database for waste service companies (WSC_DB), which will be made separately from WI_DB. By using this database, those discharging waste (factories) will be able to obtain accurate information on WSCs. Using both of these databases, it will be possible to obtain highly reliable information on off-site treatment and disposal.

d. Summary of the Waste Inventory Database

Once factories use the same format to submit the waste inventory, and these are put into a database, it will be possible to easily aggregate and analyze the data.

SUFRAMA will organize a new IWM group to assist factories and manage the WI database.

Once a factory creates its WI for the WI_DB, form next year it will only need to update some information such as amount of raw materials used and waste amounts generated, etc. The WI submitted in the year 2008 (IWM data for 2007) has already been entered into the WI_DB. In addition, the factory survey data conducted in 2009 (IWM data for 2008) also has been input into the database.

The general scheme of the WB_DB is shown in the figure below.

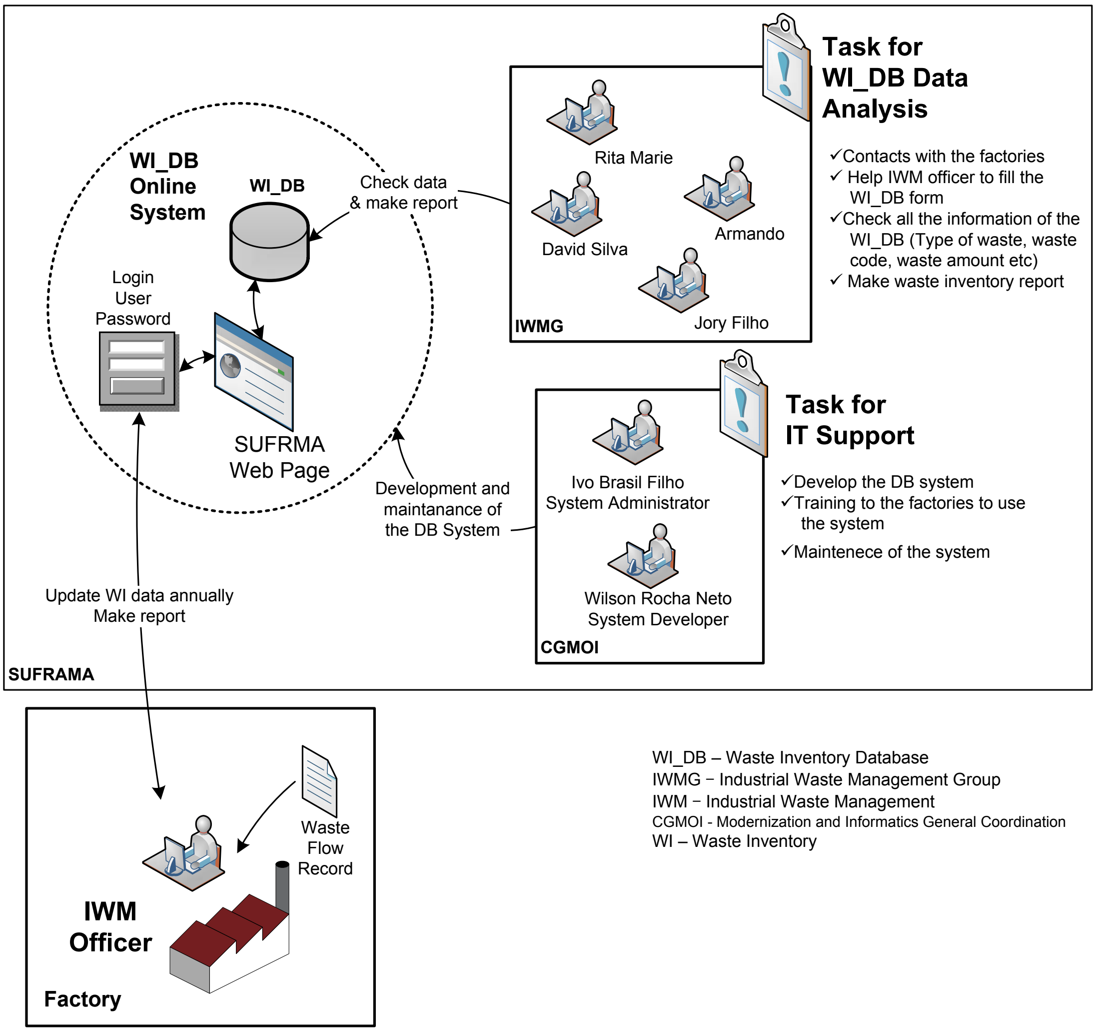


Figure 6-3: General Scheme for Implementation of the WI_DB

6.3.2 Requirements for Preparation of Waste Manifest

The waste manifest system was not provided in the study in a concrete format, unlike the waste inventory (WI) management system and waste service company registry management system. However, in the study, it was proposed that IPAAM quickly prepare this system in cooperation with advanced states, such as Rio de Janeiro. Subsequently, the requirements to create the waste manifest system were prepared as shown below, based on the assumption that IPAAM would introduce the method used in Rio de Janeiro.

a. General Information

The waste manifest (WM) is the basic document used to facilitate the waste manifest system. The WM provides information about the wastes and their origin, transport, and destination, and establishes joint responsibility between the generator, transporter and receptor, including final destination of the waste. The diagram below visualizes the concept of the proposed waste manifest system.

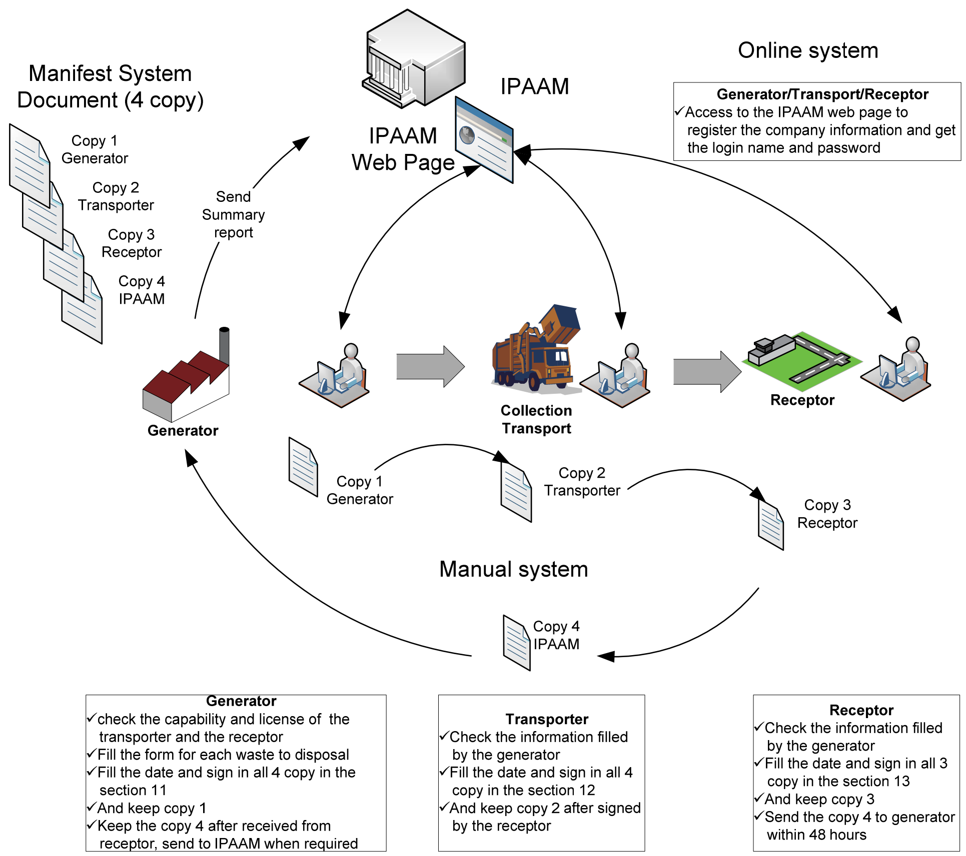


Figure 6-4: Concept of the Proposed Waste Manifest system

The waste manifest (WM) is issued in four copies by the waste generator, who keeps one and sends the others to the transporter together with the waste. The transporter keeps one copy of the WM and delivers the waste and remaining two copies to the waste receptor. Finally, the receptor receives the waste, keeps one copy of the WM and returns the last one back to the generator, completing the cycle. IPAAM will indicate which sheet will remain with each respective party.

Although the generator issues the original WM, a manager will be contracted to oversee the service. The WM should be issued specifically for each type of waste, even when several types are transported in a same load or when several loads of the same waste are transported together. Furthermore, even when several loads are transported by the same transporter or delivered to the same receptor, each load should be accompanied by a specific WM.

IPAAM will designate a unique serial number for each set of the waste manifest (4 copies) which also identifies the waste generator. This is to prevent fraud, such as any deviation from the required protocol.

All generators, transporters and receptors, public or private, in the waste manifest system will be linked to the IPAAM web page. Since the generator may receive the 4th copy of the WM, and as such, will be show up twice, IPAAM will need to define the relationship of the four (4) copies each time to avoid confusion.

The protocol of transferring and receiving the wastes within the waste manifest system is established specifically in each case at the discretion of IPAAM depending on the hazard and the amount of wastes generated by a factory's activities. General and public solid wastes are usually excluded, so the system is applied to the industrial plants' systems and their health services as well as the owners of construction sites, but excludes the domestic waste generated in those plants.

IPAAM will supply the generator with instructions, together with the serial number, and the forms or a model to make the forms.

The waste manifest form used in Rio de Janeiro is shown in the following figure.

feema — MANIFEST OF WASTES — N.__________

WASTE			QUANTITY ....tons ....m³
PHYSICAL ASPECT	ORIGIN	( ) Process ( ) ETI ( ) ETE ( ) ETA ( ) Fat Pit ( ) Out of Process ( ) Water-Oil Separator ( ) Others, specify__________	
( ) Solid ( ) Semi-solid ( ) Liquid			
STOWAGE	SOURCE	TREATMENT / DISPOSAL	
( ) Drum of 200 lts. ( ) Plastic bags ( ) Barrel ____ (lts) ( ) Loads ( ) Dumper truck ( ) Bulk ( ) Tank ____(m^3) ( ) Big-bags ( ) Others, specify __________	( ) Industrial ( ) Domestic ( ) Restaurant ( ) Shopping/Markets ( ) Commercial ( ) Clubs/Hotels ( ) Hospital ( ) Others, specify __________	( ) Sanitary Landfill ( ) Recycling ( ) Industrial Landfill ( ) Incorporation ( ) Biol./Phy-Che.Treatment ( ) Incineration ( ) Co-processing ( ) Stowage ( ) Others, specify __________	

Generator

COMPANY NAME			N. INVENTORY	__/__/__ DELIVERY DATE
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF RELEASING THE WASTE		POSITION		STAMP AND SIGNATURE OF THE PERSON IN CHARGE

Transporter

COMPANY NAME				__/__/__ RECEIVING DATE
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF THE TRANSPORTATION COMPANY		VEHICLE	COMPLETE PLATE NUMBER	
NAME OF THE DRIVER			CERTIFICATE OF INMETRO	SIGNATURE OF THE DRIVER

Receptor

COMPANY NAME				__/__/__ Receiving Date
ADDRESS				
MUNICIPALITY	STATE	TELEPHONE	N. FEEMA LICENSE	
PERSON IN CHARGE OF RECEIVING THE WASTE		POSITION		Stamp and signature of the Receiver

1st Sheet – To be kept by the Generator

THE GENERATOR SHOULD:	- fill out for each generated and disposed waste, all the fields, except the fields regarding the date and signature of the transporter and receiver; - date and sign field 11 in all the 4 sheets; - file the 1st sheet, after being dated and signed by the transporter; - deliver the other sheets to the transporter; - obey the sequential numbering strictly, sending to FEEMA the manifests which are disabled; - deliver to the transporter the Plan of Emergency, when it has to do with the transport of hazardous wastes; - file the 4th sheet of the Manifesto, received from the receptor, submitting it to FEEMA whenever requested; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the generator: company name, location, telephone, fax, e-mail, legal and representative and technician in charge; 2. list with the numbers of the manifests, identification of the waste, physical state, hazardous characteristics, destination system, form of stowage, amount, identification of the transporter and receiver; 3. list of the numbers of the disabled manifests.
THE TRANSPORTER SHOULD:	- confirm the information contained in all the fields; - date and sign field 12 in all the 4 sheets, in the presence of the generator; - file the 2nd sheet after being dated and signed by the receiver; - deliver the other sheets to the receiver; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the transporter: company name, location, telephone, fax, e-mail, legal representative, type of trucks and complete plates numbers; 2. list with the number of the manifests of the transported wastes, identification of the waste, physical state, form of stowage, amount, dates, identification of the generator and receptor.
THE RECEPTOR SHOULD:	- confirm the information contained in all the fields and inform FEEMA if divergences are found; - date and sign field 13 in the last 3 sheets, in the presence of the transporter; - file the 3rd sheet; - send the 4th sheet to the generator, within 48 subsequent hours to the reception of each waste; - send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information: 1. data of the receptor: company name, location, telephone, fax, e-mail, legal and representative and technician in charge; 2. list with the number of the manifests of the received wastes, identification of the waste, physical state, form of stowage, destination system adopted, quantity, date, identification of the generator and transporter.

Figure 6-5: Waste Manifest Form (FEEMA - Rio de Janeiro)

b. Procedures of the Generator

To consciously take his responsibilities, the Generator should:

- Nominate the Wastes Manager of his company, whose attributions will include, without restricting, the internal implementation of the Waste Manifest System, with the due instructions and trainings, and the relationship with IPAAM concerning everything about that System.
- Make sure the Transporter and the Receptor are granted with the Operation License from IPAAM, and that their equipments and facilities are perfectly qualified to render the service.
- Issue manifests for each waste and cargo, filling out all the fields in the four sections of the form, except the fields regarding to date, signature and stamp of the Transporter and Receptor.
- Write the date, sign and stamp the four sheets, in the field reserved to the Generator.
- File his sheet, after it has been dated, signed and stamped by the Transporter, to whom the other sheets will be handed in.
- Strictly follow the sequential numbering provided by IPAAM, filing the unused sheets and informing the fact to IPAAM, if requested.
- Take into account the due signaling of the transportation vehicle, and provide the Transporter with the Emergency Plan[1], in the case of hazardous wastes.
- Keep the sheet received from the Receptor for 5 years, presenting or providing IPAAM with a copy whenever requested.
- Provide IPAAM with the Wastes Flow Report on monthly basis, which will synthesize all the used and unused WM.

c. Infraction and Penalties

The non-fulfillment of the legal regulation (to be) established by IPAAM is regarded as infraction subject to the penalties set therein.

d. Completion of the Wastes Manifest

The WM is formed by 4 (four) sheets, filled out by the Generator and completed, successively, by the Transporter and the Receptor, under the previously mentioned step.

The form comprehends 4 (four) sections, with the following content:

1st Section: basic information on the waste, its generating source and destination.

2nd Section: information about the Generator and its responsibilities.

3rd Section: information about the Transporter its responsibilities.

4th Section: information about the Receptor and its responsibilities.

[1] The EMERGENCY PLAN is the plan which defines the actions to be carried out in case of fire, explosion, spilling, or emission of poisonous gases, describing the safety equipments to be used and identifying the people responsible for the coordination and participation in the emergency actions, and how to get in touch with these people.

The completion of the WM form will be as simple as the project of that form, to be done by IPAAM. The model used by INEA (former FEEMA), in the State of Rio de Janeiro, is simple and self-explanatory, for that it is presented in the Figure 6-5, as an example.

The form comprehends 4 sections and 13 fields to be filled out: The first section informs on the waste: name or sufficient identification, amount, physical state, unit, packaging, origin (plant), treatment, recycling or final disposal.

The **second section** informs on the Generator: company, address, municipality, telephone and the number of the license (OL) supplied by IPAAM; it is completed with the name of the person responsible for the outgoing and his position; the last field has the date of the delivery to the Transporter and the signature and stamp of the person in charge.

The **third section** informs on the Transporter: company, address, municipality, telephone and the number of the license (OL) supplied by IPAAM; name of the person responsible for the company and the driver, number of the plate and the certificate of INMETRO (Metrological Instruction), for the vehicle; it is completed with the signature, stamp and date of the reception of the cargo, thus taking co-responsibility for the waste flow.

The **fourth section** informs on the Receiver: the data of the company mentioned above, plus the name of the person responsible for the reception of the waste and his position; the last field presents the date of the reception, signature and stamp of the person responsible for the reception, thus taking co-responsibility for the waste flow.

e. Waste Electronic Manifest

As soon as IPAAM is qualified, it will provide the members of the Waste Manifest System - Generators, Transporters and licensed Receivers with an OL – with the option of filling out the form on-line, in its own webpage.

The access will be granted through the registration of the member in that new modality, he will receive a password from IPAAM, and his login will be the number of his registration in CNPJ/MF. The registration can be done by electronic mail, finding out the data of the company: CNPJ/MF, company name, business name, complete address, phone number, fax number, number of the license (OL) of IPAAM, the legal representative's name and the name of the technician in charge.

The completion of the WM will be done with the same information needed for the paper form, but in a faster way.

6.3.3 Good Examples of Industrial Waste Management at Generation Sources (Factories)

Since the 1990s, many factories in Japan have been aiming for “Zero Emission” from their factories due to the following reasons:

- Since the off-site disposal cost is extremely expensive--especially the landfill disposal fee--they shall reduce, reuse and recycle waste in the factory as much as possible to reduce the cost of IWM.
- The Japanese Government set up a waste management policy, “Recycling-based Society ”, through the Basic Law for Establishing the Recycling-based Society (enacted in 2000); and
- Recently, consumers tend to support companies they consider to be environmentally friendly.

"Zero Emission" is the concept that there is "zero" waste going to the landfill from a factory. The Manaus municipal landfill takes waste at no charge so it is unlikely that most PIM factories would enact waste management in the way that Japanese factories have. Nevertheless, if the Manaus landfill becomes fee-based as proposed in the Master Plan and things proceed similar to other Brazilian States, it should be possible for factories in PIM to work toward a similar situation as Japanese factories in the near future. As such, five counterpart personnel received training in Japan from the end of January to early February 2010, receiving training on efforts at the following two places.

- Kokubo Industrial Estate
- Honda Suzuka Factory

a. Kokubo Industrial Estate

The Kokubo Industrial Estate is a 958,400 square meter area established in 1975 which now has 28 factories (as of April 2009), and 5,041 employees. The total production value in 2008 was 363.7 billion yen. Kokubo Industrial Estate is located inland, away from the ocean, in Yamanashi Prefecture, and a problem with the landfill was revealed in early 1990. As a result, all 28 companies began working together so that the industrial estate generated zero landfill waste.

A diagram of their activities to do so is shown below.

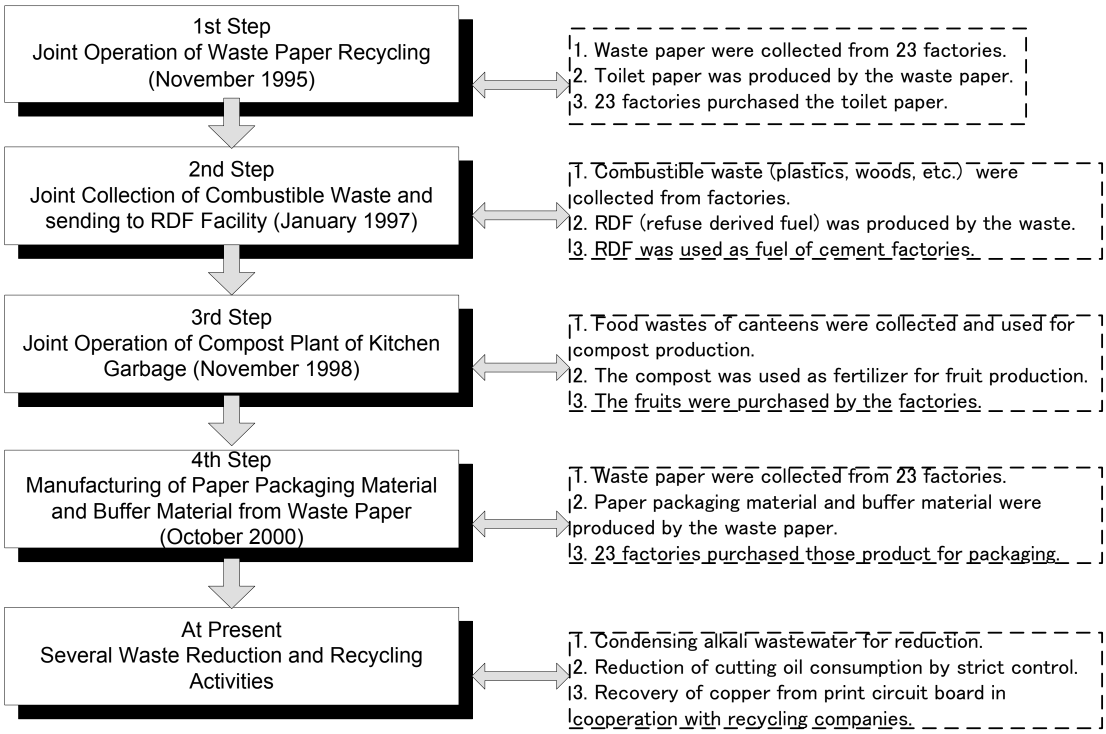
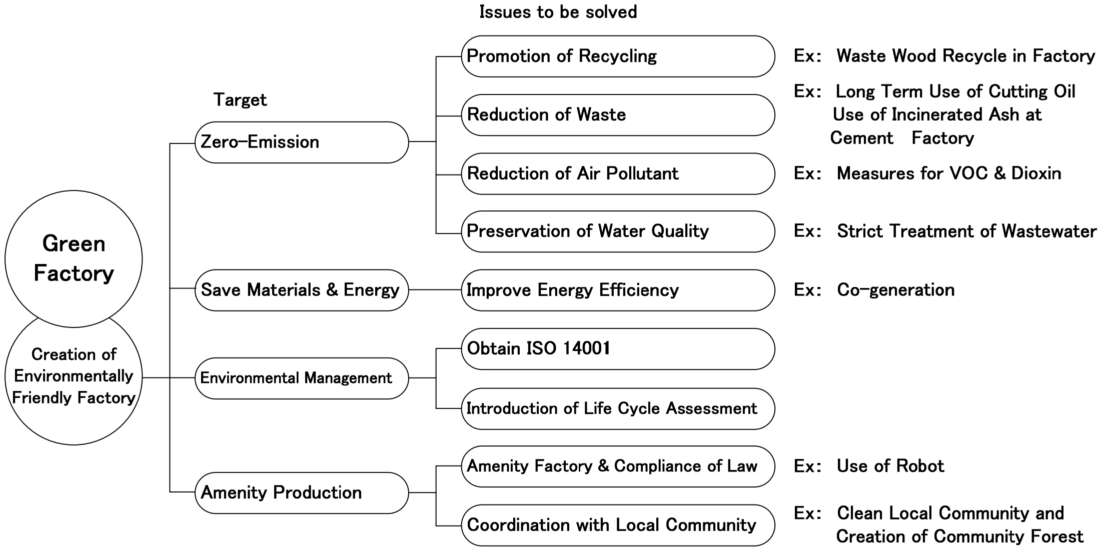


Figure 6-6: Kokubo Industrial Estate efforts for Zero Emission

b. Honda Suzuka Factory

Honda Suzuka Factory is one of the factories that achieved Zero-emission. Zero-emission is one of targets of the "Green Factory Plan" presented in the following figure. A Zero-emission team was created in the "Green Factory Project" in 1997. Zero-emission is defined as "No IWM for final disposal shall be discharged outside the factory". In 1999, Honda Suzuka Factory became the first zero-emission automobile manufacturing company in Japan.



Source: HONDA ECOLOGY (2000)

Figure 6-7: Green Factory Project of Honda Suzuka Factory

6.4 Guidelines for WSCs to Improve Waste Management

6.4.1 Requirement for Application of Operation Licence

a. Necessary Conditions for Database

The waste service company database is essential for appropriate industrial waste management in PIM. The database is categorized based on the new WSC licensing code, which makes it possible for IPAAM and waste dischargers (factories) to easily confirm the activities of the companies and select a company with which to contract according to the code.

Waste service companies are registered in the database according to code for the waste they handle, and further sub-categorized based on their activities (collection/transportation, intermediate treatment, reuse/recycle, final disposal). Accordingly, the application form will also call for these activities to be filled in.

IPAAM will manage the companies' applications into a database of waste service companies (WSC_DB). Furthermore, the WSC_DB will be made available online so that waste dischargers, such as factories, will be able to access and view the information using a password.

The application for WSCs conducting collection and transportation is shown below. The forms for other activities are given in the Supporting Report.

Table 6-6: Application Form for Collection and Transportation Activities

OPERATION LICENSE
TRANSPORT

1. General Information					
Company / Interested party:					
CNPJ / CPF:		**State Registration Number (SEFAZ-AM):**			
Mail address:					
District:		**Municipality:**		**ZIP:**	
Phone:			**Fax:**		
E-mail:					
Representative:			**Title:**		
Employee number:	Administration		Operation and Maintenance		
Area	Total (m2)		Plant (m2)		

2. TYPE OF LICENSE					
Type:	( ) Operation License – OL / ( ) Renewal:				
IPAAM Registration n.:		**Process N.**		**License Code**	
Business					
Starting date:		**Expiration date:**		**Validity of the license:**	
Polluting/Degrading Potential				**Size:**	
This license has restrictions:					
Location:					
Geographic Coordinates:	**Latitude:**		**Longitude:**		
Name of the Representative					
Phone:					
Name of the Technical Management Assessor (IPAAM):					
Name of the President Director (IPAAM):					

3. Type of Transport License Waste	
A	Transportation of non-hazardous industrial wastes

4. List of restrictions and/or conditions for the validity of this license

1. Restrictions 1
2. Restrictions 2
3. Restrictions 3 etc.

4. Transportation vehicel list

N.	**Plate**	**Brand**	**Model**	**Load capacity**	**Obs. (Picture)**
1					
2					
3					

b. Necessary Conditions for Approval through checking

It will be necessary for IPAAM to confirm that the information received from WSCs on their application form is filled in correctly. If there is an error, IPAAM will have to indicate this and instruct the applicant to correct the mistake.

An application will be need to be accepted for each activity. The requirements for license approval are given in the Supporting Report.

The table below gives some simple definitions for the activities which WSCs will submit applications.

Table 6-7: Types of Activities and Definitions for WSCs Licensing Application

Types of Activity	Definitions
Collection and Transportation	This indicates the collection of waste from the place it is generated and transporting it to a designated place. The designated place will be an intermediate treatment facility, reuse/recycling facility or final disposal site (landfill). However, this does not cover temporary storage at a place owned by the collection/transportation company.
Intermediate treatment	This indicates waste treatment through a process such as incineration. Residues leftover from this process will be recycled or taken for final disposal site.
Reuse /Recycle	This indicates recovery of valuable materials (paper, metal, PET-plastic, etc.) through the treatment of waste. This also includes production of products by using wastes as raw materials through some kind of process. The co-processing, such as when all waste is used as fuel or manufacturing raw materials at a cement factory, which does not produce residue, is also considered as recycling, although the co-processing is considered as the final destination of waste.
Final disposal	This is the final acceptance of waste and a final disposal site such as landfill.

A technical standard for the application of each licensing activity will be established by IPAAM for the facilities used for each of these activities. A general technical standard in regards to the four activities is proposed by the JICA Study Team in the Supporting Report. This technical standard will need to be duly reviewed within IPAAM to prepare regulation for a final draft of the technical standard.

6.4.2 Requirements for the Issuance of the Waste Manifest (WM)

The WSCs (Transporter or Receptor) shall follow the sub-items “General Information” and “Infractions and Penalties” and “waste Electronic Manifest” presented in item 6.3.2 as requirements for the issuance of the waste manifest (WM).

a. Procedures of the Receptor -

To consciously take his responsibilities, the WSCs (Transporter or Receptor) should:

- Nominate the Wastes Manager of his company, whose attributions will include, without restricting, the internal implementation of the Waste Manifest System, with the due instructions and trainings, and the relationship with IPAAM concerning everything about that System.

- Confirm the transporter have signed the three sheets of the WM.
- Write the date, sign and stamp the three sheets, in the field reserved to the Receptor.
- File his sheet and keep it for five years; and return the other sheet to the Generator within two days after the reception of the waste.
- Provide IPAAM with the Wastes Flow Report on monthly basis, which will synthesize all the used and unused WM.

b. Completion of the Wastes Manifest

The WM is formed by 4 (four) sheets, filled out by the Generator and completed, successively, by the Transporter and the Receptor.

The Receptor receives the cargo, keeps a sheet of the WM for himself and delivers the last to the Generator, closing the cycle of responsibilities. IPAAM will define which sheet is to remain with each of those agents.

The WM comprehends 4 (four) sections, and in the last one it informs on the Receptor: name of the company, address, municipality, telephone number and the number of the license (OL) supplied by IPAAM; it is completed with the name of the person responsible for the reception of the waste and his position; the last field presents the date of the reception, signature and stamp of the person in charge, setting his responsibility for the waste flow.

6.5 Guidelines for Administration to Improve Waste Management

6.5.1 Requirements for Management of Waste Dischargers

a. Application and Management of Industrial Waste Inventory (WI)

SUFRAMA/IPAAM will instruct waste dischargers (i.e. factories) to fill out the WI_DB registration forms. These are being entered into a database, but SUFRAMA will be responsible to manage these in the future.

The system is now in its trial period, but there are many items that will need to be improved before it is used officially. It is not possible for SUFRAMA to make the improvements on its own, and will require IPAAM and waste dischargers (factories) to cooperate and provide information.

The system is an effective measure to establish an appropriate industrial waste management system in PIM, so it is essential for SUFRAMA to assist all of the factories which constitute PIM so they are able to submit the waste inventory. The new IWM group of SUFRAMA section will be responsible for carrying out a number of important activities such as the effective application and management of waste inventories, and serving as the point of contact to work with IPAAM and factories.

b. Application and Management of Industrial Waste Manifest System (WMS)

To establish appropriate industrial waste management, it is necessary to introduce a waste manifest system (WMS). There is currently a WMS in Amazonas State, however, even with the examples provided by advanced states such as Rio de Janeiro, it will not be easy to improve this system into a practical, usable system.

It is necessary to review the current WMS in Amazonas State and identify any points that will need to be improved. An effective measure to do so will be inviting technicians from Rio de Janeiro State and so forth.

IPAAM should promptly establish an industrial waste manifest system suitable to Amazonas State so it will be possible to conduct IWM accordingly.

c. Requirements to Create the IWM Flow

One measure to industrial waste management is creating a waste flow. The waste management (treatment/disposal) flow needs to be made based on accurate information concerning both on-site and off-site waste. IPAAM/SUFRAMA will develop a waste inventory database to improve waste management for waste dischargers (factories) as well as a waste service company database to improve waste management among WSCs. Consequently, if these databases are properly managed and operated, it will be possible to use that information to create an industrial waste flow. The following figure shows an example waste flow which will be able to be made by the WI_DB if every required data are properly input.

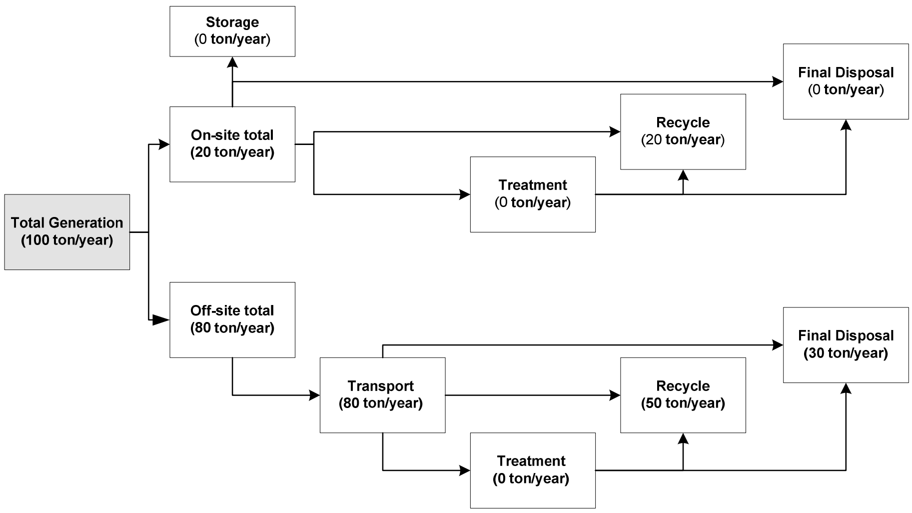


Figure 6-8: Waste flow using database

6.5.2 Requirements for WSC Management

a. Application and Management of the WSC Registry and Management System

WSCs will have to cease their activities if they do not register with this system. Consequently, this system will considerably ease IPAAM's duty to manage these companies if the data in the registry system is diligently updated. By putting this system on-line and making it possible to update the information once a year so that WSCs can be meticulously managed, it will be possible to implement appropriate industrial waste management in that administrative area.

Using this system in cases of improper disposal, such as illegal dumping, will make it possible to find the offending company.

b. Application and Management of Industrial Waste Manifest System (WMS)

The role of WSCs is critical in the manifest system. If dischargers of waste (factories) are not able to reliably entrust the treatment and disposal of their waste, it is not possible to construct a proper system for industrial waste management. IPAAM sits at the heart of this system in their role to offer guidance to waste dischargers (factories) and WSCs to properly use the waste manifest system.

c. Requirements to Create Industrial Waste Treatment and Disposal Flow

Once it is possible for waste dischargers (factories) to select the appropriate company for collection and transportation, intermediate treatment, reuse/recycling, or final disposal using the WSC database, it will be possible to realize proper off-site management of industrial waste.

Having the information on WSCs available is extremely valuable to waste dischargers (factories) when making the waste inventory. If they do not have information regarding the off-site management of waste, it is not possible to create the on-site and off-site waste flow. In other words, this makes it possible for factories to clarify how their waste is being treated, recycled or disposed of by the WSC.

6.5.3 Good Example of Off-site IWM

a. Good Example of IW Administration in Japan: Waste Service Company Rating System and Environmental Fund in Iwate Prefecture

a.1 Introduction

Industrial waste administration in Japan is legally entrusted to prefectural and dedicated (large population) city governments by the central government according to a nationwide essentially uniform standard so that some regions are engaging in effort to promote appropriate industrial waste administration.

a.2 Background

Iwate Prefecture is located in Japan’s northeast, with an area of approximately 15 thousand square kilometers and a population of around 1.4 million.

It is a picturesque prefecture largely dominated by primary industries such as agriculture, but in recent years had been wrestling to get to the bottom of a large-scale illegal dumping case near the border with Aomori Prefecture to the north, to prosecute those responsible and return conditions to normal. The industrial waste was brought from the Tokyo metropolitan area and dumped illegally, but service contractors in Iwate accepted the waste, making this a major case that required a great deal of time and resources to resolve.

a.3 System Summary

As detailed below, a company rating system and an environmental fund system were established based on Iwate Prefecture’s “Ordinances for a Recycling-based Society”.

a.3.1. Rating System

The prefecture announced a system to approve waste disposal contractors (and rate them) according to a prescribed and fixed standard. Waste Service Companies (WSCs) that are approved (and rated) can expect more social trust, and generators of waste have meaningful information to select preferred WSCs. Those companies are rated into one of 3 levels that is valid for 2 years.

a.3.2. The Fund

WSCs prepare a fund to be set aside for unforeseen incidents, which would be returned if it is necessary to deal with urgent incidents. Each company contributes 1 million yen, or 500 thousand yen for members of the Iwate Prefecture Industrial Waste Consortium, which operates the fund. Thanks to this fund, WSCs are able to appeal to waste generators with more reliable disposal qualification.

a.3.3. Public Announcement

The ratings and fund contributors are publicly announced on a website and in local newspapers.

Number of Companies (F.Y. 2008)

Rated WSCs:	54
Fund Contributors:	81

a.4 Results

Waste generators are able to select preferred WSCs, fostering preferred operators and eliminating malicious ones.

WSCs raise their awareness through participating in the system and improve self management and regulation.

a.5 Application to Improve Industrial Waste Management in Manaus

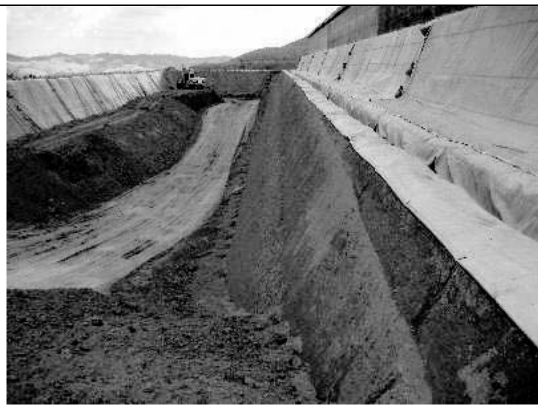
Fostering healthy WSCs is a key issue and lies at the heart of this study. Introduction of this system would further clarify and foster preferred operators, and the introduction of an environmental fund will enable reliable and assured service to waste generators

b. Sao Jose Dos Campos Landfill of Sao Paulo State

b.1 Outline of the Landfill

The Sao Jose Dos Campos Landfill is the first HW landfill in Brazil, established in 1985. It is also the first landfill in Brazil to have received ISO 14000. Now its area has been expanded up to 756,000 m^2. The HW landfill has been developed step-by-step and its operation area is limited. Each landfill is 120m (Length) x 30m (Width) x 8m (Height) with a roof. Each site must receive an operation license.

Current HW Landfill



New HW Landfill under Construction

b.2 Good Example

In 2007, Sao Jose Dos Campos City refused to accept hazardous wastes as well as non-hazardous industrial wastes. The factories requested that non-hazardous industrial waste be accepted at a private hazardous waste landfill, Sao Jose Dos Campos Landfill. Then, from 2007, the HW landfill began operations to dispose the Class II-A waste (Non-HW) of factories. Accordingly, the municipal regulation has provided a new business opportunity for the private entity, and has contributed to the city to avoid mixed disposal of low-risk municipal waste with non-hazardous industrial waste that was at high risk of being mixed with hazardous waste.


Current Non-HIW Landfill


Previous Non-HIW Landfill

7. Recommendations

7 Recommendations

The purpose of the Master Plan (M/P) formulated in this study is to "establish an appropriate industrial waste management system" for the target study area in 5 years, in the year 2015. This is a highly ambitious timeframe to achieve this plan, and thus a number of difficult issues will need to be solved in order to implement it. The JICA Study Team offers the following recommendations concerning how related organizations should approach solving those issues.

7.1.1 Use of Waste Inventory

a. Effectiveness in using the Waste Inventory

Through the proper completion of the waste inventory (WI), and aggregation, analysis and management of the data, CONAMA Resolution 313 aims to effectuate the following outcomes in relation to related stakeholders.

Generators (Factories):

Factories are able to grasp actual on-site management conditions of all waste generated from factory activities and to bring to light any issues concerning the management system. In addition, this also allows factories to grasp the management conditions of off-site waste disposal and prevent the occurrence of any improper treatment or disposal.

WI Management (IPAAM):

By aggregating and analyzing the data contained in the waste inventories submitted by factories, it is possible to understand the current conditions surrounding industrial waste management in PIM and Amazonas State, as well as any issues that may exist. This makes it possible to formulate an appropriate improvement plan to resolve those issues.

Supervisor of the Industrial Pole of Manaus / Industrial Districts (SUFRAMA):

Once the management conditions of industrial waste generated in the Industrial Pole of Manaus (PIM) and the Industrial Districts are understood, this will fulfil one of the conditions required by the Amazonas State Public Ministry in order for the Industrial Districts (DIs) to acquire environmental licensing. Also, by clarifying the management conditions of industrial waste, it is possible to offer the information required by investors planning to enter PIM.

b. Aim of the Waste Inventory Database (WI_DB) System

The proper completion and use of waste inventories will bring about the above outcomes. However, at present, almost none of the above outcomes have been realized. The reason for this, as judged by the Study Team, is that concerned stakeholders do not have a strict understanding of the intent of CONAMA Resolution 313. Therefore, the WI_DB system was developed in the Study in order to resolve the issues concerning waste inventory, as outlined below:

- By standardizing the measurement units used in the WI, generators are able to easily process the report content as data, converting as much as possible into code and avoiding any discrepancies due to differences in measurement units.
- By making it as easy as possible to compile the information sought by CONAMA Resolution 313, it will eliminate differences in reporting methods and content.

- If generators correctly enter the data according to the WI_DB system user's guide, it will be possible for each factory to depict the on-site and off-site disposal of its waste. In other words, the proper completion of the WI will contribute to some extent in factories establishing a waste management system.
- Furthermore, this will allow those managing WI (i.e. IPAAM) to easily aggregate and analyze the waste inventories submitted by each factory.

c. Roles of IPAAM and SUFRAMA for the Effective Use of the WI_DB System

IPAAM has the legal right to instruct generators (factories) on the submission of the waste inventory (WI), and the legal obligation to aggregate, analyze and report the submitted WI to the federal government (IBAMA). Therefore, SUFRAMA has neither the right nor the obligation to engage on behalf of the government in dealing with WI. Nevertheless, it is recommended that IPAAM and SUFRAMA take the following measures given that IPAAM does not currently have sufficient capacity to instruct or manage WI, and since SUFRAMA has voluntarily attempted to aggregate and analyze the WI that have been submitted thus far. In addition, the results from aggregating and analyzing the WI serve as important information to be used to manage PIM/DI and acquire its environmental license.

1. Until IPAAM is competent to carry out instruction and management of the WI, it will enter into an agreement with SUFRAMA in which IPAAM will entrust part of their right and obligation concerning the WI as follows. SUFRAMA will diligently carry out the work entrusted to them by IPAAM.
   - Factories (generators), which are responsible for completing the WI, will be instructed on how to accurately prepare the data and report the results according to WI_DB system user's guide.
   - Responding to factories that have questions regarding preparation of the WI with the necessary correspondence and instruction.
   - Distribute the file for the WI_DB system according to factory requests.
   - Aggregate and analyze the aggregated information on the WI submitted by factories.
   - Analyze any issues concerning the current WI_DB system and user's guide revealed through the process of aggregating and analyzing the WI submitted by factories, and make the necessary improvements.
2. IPAAM will cooperate with SUFRAMA using the improved WI_DB system and user's guide to instruct and assist all PIM factories to submit their waste inventories.
3. In addition, IPAAM and SUFRAMA will work together to analyze the aggregated WI, and then IPAAM will prepare the report to submit to IBAMA.

d. Disseminating the WI_DB System to other States and Industrial Parks

As shown in the following image, the WI_DB system developed in the study will clarify the waste management conditions at each factory (see a.1, below). This is made possible if each factory correctly fills out files on the system (if the factories complete the waste inventory). Then, based on what is known about these conditions, it is possible for each factory to formulate a management plan for industrial waste (see b.1).

Next, the factories will use the system files to prepare their WI, and if the individual results are compiled for the industrial park, it is possible to know the waste management conditions for it (see a.2). Then, based on what is known about the waste management conditions of the industrial park, it is possible to each industrial park to formulate their own industrial waste management plan (see b.2).

If the same is done in each State, it is even possible to clarify the waste management conditions for the country (see a.3, a.4), and formulate an industrial waste management plan (see b.3, b.4).

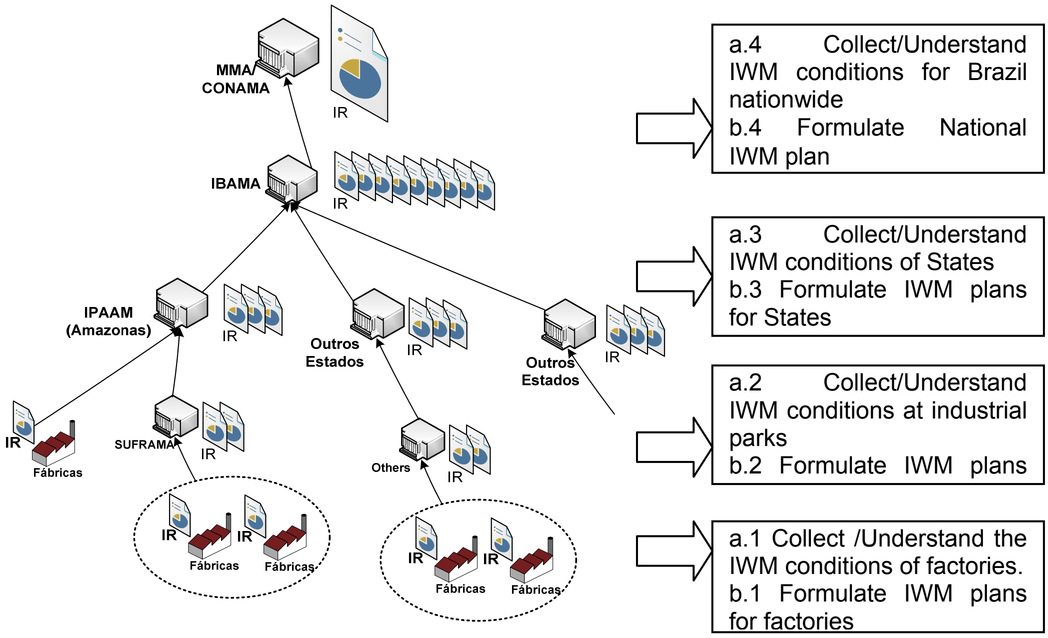


Figure 7-1: Using the WI_DB system and its relationship to understanding waste management at the factory, industrial park, state and national levels

As shown above, the Study Team considers the WI_DB system developed in this study as a highly effective tool to establish waste management systems in other States and industrial parks in Brazil, as intended by CONAMA Resolution 313. Consequently, the concerned organizations are recommended to promote dissemination of the WI_DB system and promulgate the intent of CONAMA Resolution 313 nationwide, contributing to conditions where industrial waste management systems can be established in each State.

1. First, Amazonas State will demonstrate that, using the developed WI_DB system as intended by the study team, it is possible to know the waste management conditions of each factory, related groups of factories and the State. In particular, this will confirm whether or not the waste stream can be drawn up. If so, the system will be spread to other States as follows.

2. The Ministry of Environment (MMA) collaborates with the Ministry of Development, Industry and Foreign Trade (MDIC) and the Brazilian Cooperation Agency (ABC) to hold a seminar for stakeholders in each State to disseminate the WI_DB system.

3. When holding the seminars, seek cooperation with SUFRAMA and IPAAM which are experienced in using the WI_DB system.

4. SUFRAMA and IPAAM, in response to a request by the Ministry of Environment (MMA) will actively dispatch technicians with experience in using the WI_DB system.

7.1.2 Construct a System to Manage the Licenses of Waste Service Companies

a. Aim of Waste Service Company License Management System

The background and aim of the waste service company license management system recommended in the Study are given below:

1. Currently, operation licenses for waste service companies (WSCs) are registered under various licensing codes. Because of that, it is not easy for IPAAM, which manages the licenses, or for generators (factories), which entrust the treatment and disposal of their wastes to waste service companies, to know the exact number of entities with licenses or what activities licensed entities are permitted to undertake.
2. The recommended system to manage the licenses of waste service companies would use a new environmental license code specifically for WSCs (four-digit codes starting with 33**, for municipal waste, and 34**, for industrial waste), integrating WSCs with two environmental license codes.
3. Also, the content of the license are divided into 4 major categories: 1) collection and transportation, 2) intermediate treatment, 3) recycling, and 4) final disposal. The content of each of these activities are further specified and managed in the waste service company database (WSC_DB).
4. On that basis, the information generators (factories) need to select the companies to which they will entrust disposal of their waste will be available on the IPAAM website.
5. Once the above is established, generators will be able to entrust the disposal of their wastes to trusted companies, and IPAAM will be able to eliminate companies without licenses and monitor that those which do have licenses are conducting appropriate activities.

b. Issues for the Use of a Waste Service Company License Management System and Strategy for Resolutions

As mentioned above, the waste service company license management system recommended in the Study is of great importance to “establish an appropriate industrial waste management system” in the target study area. However, it is not possible for the system to function unless waste service companies are required to obtain an operation license according to the proposed system. Therefore, it is suggested that the concerned organizations observe the following:

1. IPAAM will quickly revise its current licensing system and undertake measures so that the recommended license management system is part of the legal system. This means that it is necessary to carry out the required steps to deliberate the recommended license management system in the State Legislature (such as formulating a proposed revision of the law).
2. IPAAM will cooperate with SUFRAMA to move ahead with activities to promote the necessity of the recommended license management system to stakeholders.
3. Once the recommended license management system has become integrated into the system, IPAAM will immediately proceed with registration, and construct the WSC_DB.

4. Once the WSC_DB is constructed, IPAAM will make certain information about the newly licensed waste service companies, such as contact information and what licenses they hold, available on its website.

7.1.3 Other

a. Use of the Guidelines to Improve Industrial Waste Management

The guidelines to improve industrial waste management in PIM were produced to support the aim of the M/P to "establish an appropriate system to manage industrial waste in the Industrial Pole of Manaus." The guidelines summarize the required actions to achieve the M/P objectives upon the understanding of waste generators, waste service companies and administration. It is suggested that those three parties make effective use of the guidelines to improve industrial waste management and establish an appropriate system of industrial waste management in PIM.

b. Form a Memorandum of Understanding concerning Implementation of the Master Plan

The authority to enforce the laws necessary to implement the M/P lies primarily with IPAAM. However, the various organizations will need to cooperate in a number of ways, as outlined below, for stakeholders to comply with the law in accordance with instruction and guidance by IPAAM and fulfill their respective obligations.

- SUFRAMA will grant various investment incentives to direct PIM factories to comply with regulation. Also, for waste service companies, SUFRAMA will attract the construction and operation of appropriate treatment and disposal facilities.
- The City of Manaus will make the current landfill fee-based, and promote the construction of a new landfill that is able to obtain an environmental license.
- The Public Ministry of Amazonas State will support IPAAM to enforce laws and regulation.
- Generators and wastes service companies will comply with laws and regulation and construct the respective systems for industrial waste management.

It is recommended that IPAAM clarify the roles and responsibilities of the related organizations and form a Memorandum of Understanding between those concerned with implementing the M/P.

c. Preparing the Electronic Waste Manifest System

An electronic waste manifest system is extremely effective to trace the route of waste after it is discharged from a factory until its final destination. However, this requires not only development of the system, but also various types of expertise in how to properly operate the system. Therefore, in order to prepare such a system, it is recommended that IPAAM explore policy measures as follows.

1. Cooperate with other states that have already prepared an on-line waste manifest system, such as Rio de Janeiro State, and develop a system in Amazonas1.

[1] Rio de Janeiro State Institute of Environment (INEA) has essentially already agreed to cooperate and dispatched an expert to present at the second workshop held on November 27, 2009.

2. In order to use the on-line waste manifest system properly once it has been developed, seek cooperation to dispatch engineers with actual operation experience.

d. Formulating an Environmental Management Plan for the Industrial Districts (DI) and Acquiring an Environmental License

At present, SUFRAMA has been advised by the Public Ministry of Amazonas State to obtain an environmental license for the Industrial Districts (DIs). In order to do so, it is necessary to formulate an environmental management plan, including the proper management of industrial wastes, for the DIs as a whole. SUFRAMA is recommended to cooperate with IPAAM to reach a policy as follows:

1. In this study, the results of a factory survey of 187 factories have been compiled into a database. That database is currently kept and managed by Modernization and Informatics General Coordination (CGMOI, under SAD) at SUFRAMA.
2. The factory survey results for 187 factories contain data on factories outside of the DI. The system engineer of CGMOI would extract only the DI survey results and compile these in order to understand the IWM conditions of the industrial districts.
3. Also in the factory survey, data was gathered not only on IWM, but also on pollution control facilities. These survey results can also be extracted and compiled only for the DI.
4. The environmental management conditions of DI will become clear through the above steps. In addition, an environmental management improvement plan for DI can be formulated by making use of the industrial waste management plan produced in this study.
5. Collaborate with IPAAM to further refine the environmental management improvement plan for DI and submit it to the Public Ministry of Amazonas State.

e. Promote Appropriate Treatment and Disposal and the 3Rs

In March 2010, the National Congress approved the Substitute of Draft Bill No. 203, National Policy on Solid Waste, which stresses appropriate treatment and disposal, and the 3Rs. Regardless of on- or off-site disposal, strengthening regulation is the most effective means to promote proper treatment and disposal, and the 3Rs.

Namely, if the administrative side (IPAAM) develops a management system and strengthens control of appropriate treatment and disposal, the off-site disposal fee will be raised. By raising the off-site disposal fee, it will not be possible for generation sources (i.e. factories) to commission 95% or more of the waste generated, as it is now. The result is that PIM factories, like those in Japan, will promote on-site 3R and reduce the amount disposed of off-site.

Also, in response to regulations and putting various environmental measures in place, disposal costs will rise even for off-site treatment and disposal. With that, waste service companies will want to reduce the disposal costs by reducing the amount of residues after treatment or by actively reusing or recycling residues. In states with more advanced destination practices, such as Rio de Janeiro, co-processing is widely used, mainly by cement factories which do not generate any waste after processing.

In order to encourage co-processing at cement factories, in addition to introducing a disposal fee, waste blending techniques that do not affect product or cement quality will need to be introduced. With that, to encourage even better treatment and disposal techniques and 3R measures, IPAAM should be encouraged to not only strengthen regulation, but to actively provide information to both waste generators and WSCs about appropriate treatment and disposal and the 3Rs, and offer training and guidance where needed. Furthermore, ideally, IPAAM would hold a training seminar for both waste generators and WSCs with the cooperation of stakeholders from states and countries with more advanced practices.

Finally, IPAAM should instruct the companies to elaborate their Wastes Management Plan, the basic instrument used to devise rational and economic handling and destination, including the procedures to minimize the wastes and costs they bear.

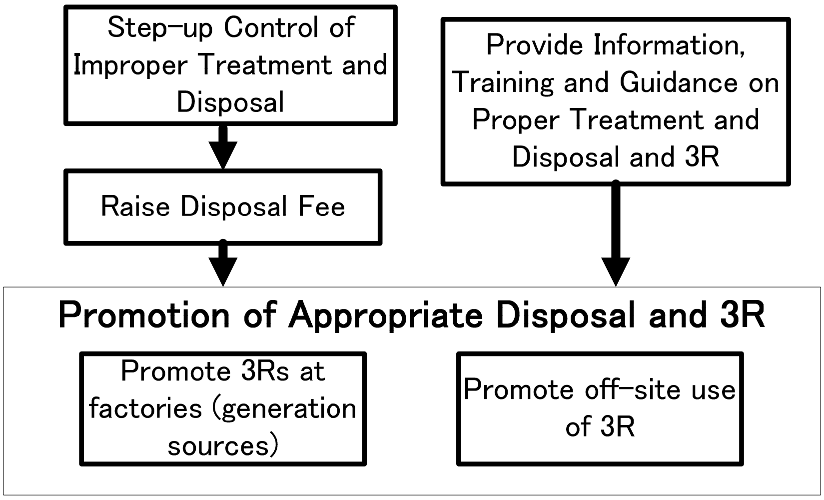


Figure 7-2: Promotion of Appropriate Disposal and 3R

f. Improve Business Environment for Waste Service Companies

The Waste Service Companies (WSC) are responsible for the proper treatment and destination of the wastes from the factories, and need to make satisfactory investments and bear the operational and maintenance costs to treat and dispose of industrial wastes entrusted to them according to proper standards. However, due to the presence in the study target area of non-licensed companies which conduct improper disposal to undercut actual costs, and the fact that the landfill accepts wastes at no charge, the conditions make it infeasible for the WSC to bear the costs brought by good practices. In order to improve the current business environment, IPAAM and SUFRAMA should cooperate and introduce the following measures to encourage WSCs to engage in proper treatment and disposal:

1. Secure demand for industrial waste services by eliminating the non-licensed companies and controlling improper treatment and disposal. For that, IPAAM and SUFRAMA should proactively publicize the information on the registration of WSCs in the database of waste services companies (WSC_DB), and inform the generators (factories) that this information is available.
2. Next, establish a sole and exclusive area at the Manaus City landfill for fee-based disposal of Class II-A/Non-hazardous/Non-inert IW, and promote separate disposal of Non-hazardous/ Non-inert IW and municipal waste in separate site.

3. Encourage the co-processing in clinker ovens as a good alternative for the destination of hazardous IW, as well as the establishment of blending plants for the wastes to be co-processed.
4. Instruct waste generators to contract WSCs registered in the WSC_DB for disposal, and provide technical information to promote on-site 3R, including training and guidance.
5. Also, hold training seminars for WSCs to instruct and guide them with information an appropriate treatment and disposal techniques.
6. Furthermore, adopt the good examples[1] from other advanced states such as Sao Paulo to improve the business environment for related industries. In Japan, many prefectures have recently introduced a "reward system for preferred waste service companies" which has been effective. In Brazil, the examples of business award and promotion are trophies and Green Stamps.

g. Cooperation between Administration, Generators and Waste Service Companies

Finally, in order to attain the "establishment of an appropriate industrial waste management system", it is essential that administration, generators and waste service companies all collaborate. In order to strengthen collaboration between these three sides, IPAAM is recommended to take the following measures.

1. Further strengthen the ties between related administrative organizations by establishing a (tentatively named) Coordination Committee for Proper Industrial Waste Management Promotion (hereafter referred to as the CCPIWMP). It is presumed that the CCPIWMP would be developed by members of the Technical Sub-Committee (TCSC) who participated in the weekly meetings during this study. The CCPGRIA will discuss the duplicated licenses, inspection, surveillance and punishment by IPAAM and SEMMA.
2. The CCPIWMP would be central to encouraging cooperation amongst and reinforcing ties between administration, waste generators, and waste service companies. To do so, the administrative side would hold a (tentatively named) Proper Industrial Waste Management Promotion Committee (hereafter simply referred to as the PIWMPC).meeting of these entities for them to come to an understanding on various issues and strengthen ties.

The administrative side would publicize, educate and train waste generators on the necessity of appropriate disposal, making them aware of their responsibilities for appropriate disposal and ensuing expenses. Then, educate and train WSCs on appropriate disposal methods, impressing upon them the necessity to implement appropriate disposal techniques.

[1] Sao Jose Dos Campos Landfill Example: In 2007, Sao Jose Dos Campos City refused to accept hazardous wastes as well as non-hazardous industrial wastes. The factories requested that non-hazardous industrial waste be accepted at a private hazardous waste landfill. Accordingly the municipal regulation has provided a new business opportunity for the private entity, and has contributed to the city to avoid mixed disposal of low-risk municipal waste with non-hazardous industrial waste that was at high risk of being mixed with hazardous waste.