The Generation and Management of Hazardous Wastes and Transboundary Hazardous Waste Shipments between Mexico, Canada and the United States, 1990–2000

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Summary

The paper examines the impacts of NAFTA and trade liberalization on the generation, management and shipments of industrial hazardous wastes in Mexico, Canada and the US. The paper looks at whether economic activity in the manufacturing and hazardous waste management industry have become more concentrated in the US–Canada and US–Mexico border regions, and what the impacts of that concentration have been. In addition, the paper considers whether hazardous waste is being shipped from one country to another or whether companies are investing in hazardous waste facilities in any country to take advantage of less stringent hazardous waste regulations and enforcement.

The paper finds that the available data indicates an ongoing concentration of economic activity, including hazardous waste generation and management in the US–Mexico Border region. In the Canada–US border region, waste generation in Ontario and Quebec has been increasing significantly, particularly in the steel and chemical industries, which are concentrated in the border region, although waste generation in states such as Michigan, Pennsylvania and Wisconsin has declined. In addition, despite the decline in waste generation among the US border states, there has been a dramatic growth in US waste exports to Ontario and Quebec and, in the context of a weakened regulatory environment, a significant increase in disposal capacity in those provinces.

Differences in regulatory requirements related to hazardous waste disposal, specifically the existence of less stringent standards in Ontario and Quebec have been the key factor in the increase in US hazardous waste exports to Canada. Similarly, the expansion of disposal capacity in these provinces is in part intended to serve the US market, although the bulk of the investments in this capacity is Canadian in origin.

The ban on imports of hazardous wastes for final disposal into Mexico limits the economic incentive for the establishment of disposal capacity to deal with imported wastes to take advantage of differences in the regulatory and enforcement regime between Mexico and the US. However, there has been significant US investment through joint ventures in Mexican capacity for the treatment, incineration and disposal of domestically generated wastes, with the market for these services being driven by

stronger disposal requirements in Mexico in some cases, as well as "temporary" authorizations without publicly-approved standards in others.

Significant gaps exist in the systems for tracking hazardous waste generation and disposal in all three countries. Reliable data on waste generation in Canada and Mexico is extremely limited, and the reliability of the data regarding transboundary waste movements among the three countries has been seriously questioned. Tracking of transboundary waste movements from "cradle to grave" when the "cradle" is in one country and the "grave" in another is almost impossible.

While many of these changes have occurred outside of the NAFTA framework, the NAFTA trade rules have also been identified as a constraint on the ability of countries to adopt higher standards to protect human health and the environment. The outcomes of NAFTA chapter 11 complaints seen in such cases at the ban on MMT in Canada and the Metalclad case in Mexico seem likely to reinforce these directions to the detriment of the health, safety and environment of the citizens of all three NAFTA countries.

I. Introduction/Context

The generation and management of hazardous wastes in the NAFTA-party countries has been a major concern for decades. This paper applies the CEC's Final Analytic Framework for Assessing the Environment Effects of NAFTA to the issue of transboundary shipments of industrial hazardous waste between the NAFTA countries and to the commercial hazardous waste management "sector" of the North American economy.[1] The paper focuses on two major hypothesis contained in the Framework:

- Is trade and investment liberalization concentrating economic activity (in both manufacturing and the hazardous waste management industry) in areas where it takes place more efficiently, or conversely, where ecological stress is already acute such as the U.S. - Mexico border region and the U.S. Canada-Border Region?

- Are companies in the manufacturing or hazardous waste management sectors relocating or are they sending hazardous wastes to other areas to take advantage of less stringent hazardous waste regulations or enforcement?

Finally, the paper also examines to what extent the parties to NAFTA have established effective

[1] This paper looks only at the generation, management and shipment of *industrial* hazardous wastes and does not consider to any great extent other hazardous wastes, such as those generated in mining, petroleum exploration, agriculture, silviculture and – except to some extent in Mexico – medical wastes. Hazardous wastes are defined differently in all three countries, although there is significant overlap.

mechanisms to monitor and control the generation, transboundary movement and disposal of hazardous wastes in North America.

The paper approaches issue of impacts of trade liberalization in four steps. First, a pre-NAFTA 'base case" with respect to government policies, the roles of non-governmental actors, disposal capacity, waste generation and disposal, and transboundary waste traffic is established. A summary of the base cases is contained in the text, while the base cases themselves are located in Appendix A. Secondly, the changes introduced through NAFTA and its institutions are described. Third, the changes with respect to government policies, societal interests, disposal capacity, waste generation and disposal and transboundary traffic since 1994 are outlined. Fourth, possible explanations for these changes, including the impacts of trade liberalization, and other factors are reviewed and assessed.

I. The Pre-Liberalization Base Case (pre-1994)

Note: A summary of the base cases is presented here. For a full analysis see Appendix A. All tables and graphics from both Appendix A and this report are contained in Appendix B.

Summary of Pre-1994 Base Cases

In the United States, a comprehensive federal regulatory regime for domestic generation, handling and disposal was established in the 1970s and significantly strengthened between the mid-1980s and mid-1990s. There were some gaps in the regulatory structure as cement and

other industries burning hazardous wastes enjoyed significant advantages over other hazardous waste management facilities. Data on total hazardous waste generation prior to 1994 is difficult to assess, due to changes in reporting regime, but the USEPA believes there was a downward trend between 1989 and 1993. Transboundary waste traffic was almost exclusively with Canada and Mexico, although very limited data on waste imports and exports is available for the period prior to the mid 1990s.

Hazardous waste was generated throughout the country with significant concentrations in both border regions. The hazardous waste industry was dominated by a few players, who by 1994 had constructed more than sufficient capacity to treat hazardous waste commercially. Citizens actively opposed new facilities, successful stopping several proposed landfills along the U.S. – Mexico border.

In Mexico, the 1988 LGEEPA established a basic legislative framework for the management of hazardous wastes, including a ban on imports of such wastes for storage or final disposal and a requirement that hazardous wastes generated from raw materials temporarily imported into the country through the "maquiladora" or other similar export-promotion programs be exported back to the country of the input's origin. Some regulations to implement these provisions were adopted in 1993. Little data is available on hazardous waste generation and disposal or transboundary movement of wastes is available prior to the mid-1990s, although is thought that waste generation was growing both in the border region and nationally. The compliance of

maquiladora facilities with requirements to return hazardous wastes which they generated to the their owners' country of origin was generally thought to be poor.

At the same time, foreign companies as well as national companies were beginning to explore investment opportunities in Mexico, both for the incineration and disposal of hazardous wastes. Citizens began to become involved in campaigns to pressure government to enforce environmental laws and to prevent the opening of new hazardous waste facilities, but had few legal remedies under Mexico law.

In Canada, a basic regulatory regime for the management of hazardous wastes was established in 1970s and 1980s by all of the provinces. The role of the federal government was limited to the regulation of hazardous waste imports and exports. The available data on domestic hazardous waste generation and disposal is very limited, but generally indicates that waste generation tracked the overall level of economic activity closely. Until the mid-1990s hazardous waste imports were relatively stable, while exports increased significantly in late 80's and early 1990s. Hazardous waste imports and exports were almost entirely limited to traffic between the provinces of Ontario and Quebec and the United States.

Hazardous waste disposal capacity in Canada was very limited, with only a few commercial facilities operating in Ontario and Quebec, and those largely dating from 1960s. Various provincial efforts to establish additional disposal capacity in the 1980' s met with mixed results

in face of strong public opposition, although new facilities were established in Swan Hills Alberta and Blainville, Quebec.

A. NAFTA Rule Changes

A. NAFTA Rule Changes

1. General Provisions

Chapter 3 of the NAFTA sets out requirements for the "national treatment" of goods. Article 309 specifically provides:

> "1.Except as otherwise provided in this agreement, no party may adopt or maintain any prohibition or restriction on the importation of any good of another Party… except in accordance with Art. XI of the GATT."

Article 415 of the NAFTA defines good to include "waste and scrap derived from (I) production in the territory of one or more of the Parties." Therefore hazardous wastes are likely to be considered a good for the purposes of the Agreement, and the right of Parties to prohibit or restrict their import may therefore be limited.

Article XI of the GATT permits countries to impose restrictions or bans on imports of goods, via article XX where such measures are "necessary to protect human, animal or plant life or health." The term "necessary" has been interpreted to mean that the country maintaining the ban

must show: (1) there is no reasonable available alternative measure consistent with with the GATT to achieve the desired end and (2) the measure taken is the least trade restrictive measure available.

2. Hazardous Waste and NAFTA

NAFTA declares that major multilateral conventions on hazardous waste disposal, as well as bilateral agreement on hazardous waste shipments and disposal take precedence over NAFTA itself. Specifically, Article 104 provides that:

> In the event of any inconsistency between this agreement (NAFTA) and the specific trade obligations set out in…
>
> (c) (the Basel Convention on the Transboundary Movement of Hazardous Wastes, on its entry into force for Canada, Mexico and the US…
>
> such obligations shall prevail to the extent of the inconsistency, provided that where a party has a choice among equally effective and reasonably available means of complying with such obligations, the Party choose the alternative that is least inconsistent with the other provisions of (NAFTA).
>
> (d) the agreements set out in Annex 104.1 (these are the 1986 *U.S. Canada Agreement on Transboundary Movement of Hazardous Waste* and the 1983 *U.S.-Mexico Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area* (the La Paz Agreement)

Article 4 of the Basel convention permits countries to ban or restrict imports of hazardous waste if they have reason to believe that the wastes will not be managed in an "environmentally sound manner." While both Canada and Mexico have ratified the Basel convention, the U.S. has not, making the two binational agreements currently more relevant to NAFTA. Both these agreement establish the mechanisms for imports and exports between the countries. Of particular importance is Annex III of the La Paz agreement, which states that as long as applicable hazardous waste regulations are met, either country must accept the return of hazardous waste generated by production from raw materials that were imported under a temporary import regime. In practice, this requirement, along with Mexican regulations adopted under the LGEEPA, has meant that most maquiladoras are required to send their hazardous wastes back to the U.S.

In addition, while NAFTA does not address the maquiladora program wholesale, several provisions of NAFTA do change some unique features that have fostered their export orientation. On the one hand, under Article 303, NAFTA continues to allow the duty drawback (repayment of the in-bond) on NAFTA-originating inputs to the extent tariffs still remain, while phasing out both requirements on the % of sales which must be exported outside of Mexico and other export performance requirements by January 1, 2001 (NAFTA, Article 304). These changes lessen the advantages between being a maquiladora and being a national Mexican company and some have suggested that maquiladoras might nationalize, at least partly to escape the repatriation of hazardous waste required under the La Paz Agreement.

Article 1114(2) of the NAFTA declares that Parties should not waive or relax environmental measures in an attempt to attract foreign investment. Article 1110, on the other hand, states that no Party may directly or indirectly nationalize or expropriate an investment of an investor in another Party in its territory or take a measure tantamount to nationalization or expropriation of such an investment without compensation. Measures intended to restrict the import or export of substances believed to be harmful to human health have been challenged under these provisions. Examples of such actions include: Ethyl Corporation's challenge of Canada's ban on the import and interprovincial trade in MMT; S.D.Myers case for damages related to lost business due to Canada's November 1995 - February 1997 ban on PCB Waste exports to the United States; Methanex Corporation, a Canadian Company, filing a $970 million claim for California's ban of imports of a gasoline additive (MBET); and of most relevance, the recent claim won by Metalclad that Mexico violated its investor rights by not allowing it to open a hazardous waste landfill in the state of San Luis Potosí.

3. The North American Agreement for Environmental Cooperation

The North American Agreement for Environmental Cooperation (NAAEC), sometimes referred to as the Environmental Side-Agreement to the NAFTA, came into effect at the same time of the NAFTA. Articles 5,6,7, 10(4), 12 (2) collectively impose obligations on parties to effectively enforce laws; to pursue avenues of cooperation to this end; to effect specified private enforcement rights and opportunities; and to provide an annual public report on the enforcement

of environmental laws. The Agreement also provided for the creation of the North American Commission for Environmental Cooperation (CEC).

Articles 14 and 15 of the NAAEC establish a mechanism through which any resident of a NAFTA country may file a submission that assert that a NAFTA country is "is failing to effectively enforce its environmental law." To date, two cases directly related to hazardous waste mismanagement has been brought forward under the Article 14/15 process, one of which will lead to preparation of a factual record (see Section IV – Mexico Case -- for details).

Under Article 10:7 of the NAAEC, the three parties to NAFTA agreed to establish a system of notification for projects that could pose transboundary environmental impacts on another country – called the Transboundary Environmental Impact Assessment -- as well as a process of consultation and mitigation of any environmental impact. Unfortunately, the three countries have not been able to reach agreement on this provision, instead opting for voluntary agreements between states and provinces.

A. NAFTA's Institutions related to Hazardous Wastes

1. CEC: North American Working Group on Environmental Enforcement and Compliance Cooperation; and Law and Enforcement Cooperation Program;

The CEC is given a number of roles through the NAAEC. These include the encouragement of the effective enforcement by each party of its environmental laws and regulations, compliance with those laws and regulations and technical cooperation between the parties (NAAEC, Part III, Article 9 (3)). In 1995 the CEC's law and policy program initiated an ongoing project for enhancing regional cooperation for improved tracking and enforcement of North American Laws regulating the transboundary movement of hazardous wastes and chloroflurocarbons (CFCs). Similarly, the CEC has facilitated several regional agreements on "sound management" of dangerous materials such as PCBs, mercury and dioxins, all of which are in various phases of completion.

A report published in 1999 under the auspices of the law and policy program concluded that the hazardous waste tracking systems in all three countries were deficient with respect to the quality, quantity and timing of information (CEC 1999: ix).

2. Land Transportation Standards Subcommittee and Transportation Consultative Group

The Land Transportation Standards Subcommittee (LTSS) is a subcommittee of the Committee on Standards-Related Measures and was expressly authorized by NAFTA under Article 913 (5) (a) (I) and Annex 913. The primary purpose of the LTSS is to make the Parties' relevant standards-related measures on bus, truck and rail operations, including the transportation of dangerous goods, compatible. The expressed purpose of the LTSS itself attempts to harmonize regulations between the three Parties, not change policy or standards. LTSS has two specific

charges: (1) making compatible the Parties' standards-related measures for commercial vehicles by January 1, 1997; and (2) making the relevant standards-related measures for the transportations of dangerous goods compatible by January 1, 2000 (NAFTA annex 913.5.a-1), a goal it is not been able to meet despite real progress.

One of the working groups, the Hazardous Materials Land Transportation Standards Group (also called the "Working Group on the Transportation of Dangerous Goods" or LTSS Group No. 5) is following the UN's recommendations on the Transport of Dangerous Goods – adapted as necessary to the North American reality -- as the basis for making standards compatible. The three countries have substantially "harmonized" regulations regarding hazardous materials transport although significant challenges remain, notably Mexico's continued implementation of standards related to "1993 Regulations for Domestic Transport of Hazardous Wastes and Materials."[2]

In addition to the LTSS, a new Transportation Consultative Group(TCG) was formed in 1994. The TCG works on non-standard issues such as vehicle registration, entry requirements and taxation. However, thus far, environmental issues such as tanker accidents and oil spills have not been a focus of the TCG, instead being the purview of the LTSS Group No. 5 (CEC 1997: 50).

[2] For example, Mexico is still not finished adopting common labeling and transport requirements for land, sea and air (LTSS 1999).

B. Post-Liberalization? 1994 Onwards

The United States

A. Government Policy

U.S. –Federal

At the federal level, in general, the U.S. government significantly tightened regulation of hazardous wastes between 1994 and 2000, while loosening some reporting requirements. Among the most important measures taken since 1994 were new Land Disposal Restrictions Phase II, III and IV (LDR) Rules, the listing of petroleum refinery list, limitations on the "Bevill" exclusion waste, and new Maximum Achievable Control Technology regulations for incinerators and industrial furnaces authorized under RCRA and the Federal Clean Air Act. These regulations – particularly the LDR IV rules -- significantly raised the treatment levels required for waste generated in the U.S. Among RCRA rules which lessened regulations was a change in the 1997 Form for reporting generation and management of hazardous wastes and the Hazardous Waste Identification Rule (HWIR), much of which still has not gone into effect.

Table 1. Major New Rules Adopted by U.S. EPA under RCRA and CAA, 1994-2000

Enforcement

In FY 1999, EPA and state agencies inspected about 63% of all TSD facilities for compliance with RCRA and state regulations. That same year, about 11% of all TSD facilities were considered to be in significant non-compliance with RCRA rules. In general, inspection rates in the U.S. –Canada border states have been slightly higher that the national average, while inspection rates in the U.S –Mexico border region have been lower than the national average. These difference seem to reflect lower budgets in general in southern states – particularly in Texas -- for environmental protection and enforcement as well as the higher number of TSDs concentrated in California and Texas. California rates were surprisingly low during this period. While rates of inspection and formal actions declined in the mid-1990s, there has not been, however, there has been an upswing in inspections and formal actions since 1996.

Table 2. RCRA Treatment, Storage and Disposal Facilities: % Inspected, % in Significant Non-Compliance and Number of Formal Enforcement Actions, Mexican Border States, Canadian Border States and Nation, 1995-1999

In recent years, EPA has placed greater emphasis on enforcing RCRA transportation regulations on hazardous waste imports and exports through financial support to state programs and use of the HAZTRAKS database (see below). Utilizing HAZTRAKS, EPA filed 17 administrative enforcement actions against transport and TSD companies that did not comply with export or import regulations between 1996 and 1998, with penalties totaling $482,000 (Cooke, October 98). This year, the U.S. EPA fined a Mexican maquiladora facility –

Maquiladora Chambers Belt Co. – as well as its parent company and a storage facility a total of $50,000 for illegally shipping hazardous wastes to facilities not authorized to receive the waste, as well as improperly labeling, packaging and completing the manifests for the waste. It represented the first time a maquila had been fined by a U.S. agency.

In December of 1999, the governments of the Mexico and the U.S. announced the establishment of a new consultative mechanism between the two countries on new and operating hazardous and radioactive waste sites within 100 kilometers. With the new agreement, the two countries -- and by extension its citizens -- should be able to voice opinions about proposed sites for the deposit, management and recycling of hazardous and radioactive wastes.

U.S.-States

Texas

There has been a movement in some states to move toward voluntary pollution prevention programs compliance assistance, rather than strict enforcement. Thus, Texas passed the Waste Reduction Policy Act of 1991 to require industries to submit waste reduction and waste minimization plans and annual progress reports, and began a “Clean Industries Program” to assist and recognize businesses for their efforts. This may have led to significant pollution reduction.

In addition, the Texas Natural Resource Conservation Commission adopted a number of "regulatory flexibility measures" – some required by Texas legislation – during the mid-1990s, including:

B. The 1995 Environmental Audit program allowing industries to audit their facility in order to comply with regulations in return for immunity from civil and administrative penalties;
C. A 1995 policy of no surprise inspections of industries in most cases;
D. Flexible Permits (1995), allowing industries to change or increase production without a permit amendment;
E. 1997 Regulatory Flexibility Orders, exempting industries from state statute or rules in return from alternative "as protective" of public health and the environment (Sunset Advisory Commission 2000, 32).

In addition, the legislature and governor also approved a "takings" law which allows business to sue state government for "taking" their property through regulation and forced the state to consider the effect of regulation on property values. Finally, in recent years, the TNRCC has adopted a more rigorous definition of "affected party" when considering standing for citizens opposed to hazardous waste and other environmental permits. With these changes, Texas moved away from stricter regulation and toward a voluntary compliance philosophy as well as limiting public participation in permit hearings.

Table 3. Estimated Hazardous Waste Source Reductions from Large Quantity Generators in Texas, 1995-1998

Enforcement

While EPA is ultimately responsible for overseeing the enforcement of RCRA and other laws pertaining to hazardous wastes, because most states have been delegated authority, the actual inspections and enforcement activities occur primarily at the state level. In Texas, about 12,000 facilities are subject to industrial or hazardous waste regulations. Under the TNRCC, the state agency in charge of conducting inspections, issuing notices of violations and issuing penalties, either through an Agreed Order or other means, the total number of notices of violations, agreed orders and penalties has declined in recent years. Still, comparisons between the nation and the zone within the 100 kilometers of the U.S.–Mexico border do not support a conclusion that there has been less effective enforcement and inspections there since NAFTA.

Table 4. RCRA Treatment Storage and Disposal Facilities: % Inspected and % in Significant Non-Compliance within 100 kilometers of U.S –Mexico Border, FY 99

Both Texas and California have increased inspections and funds dedicated to Points of Entry inspections in recent years, although the percentage of trucks that are actually inspected by state officials is tiny. Recently, the Arizona Department of Environmental Quality began the Hazardous Waste Border Surveillance, Compliance and Enforcement Program (Border SCEP) using EPA funds (Mendoza 2000). The new programs has allowed the state agency to conduct training with U.S. Customs officials and officials from the Pima County Department of

Environmental Quality on RCRA regulations, sampling procedures and proper inspections. It is not, however, allowed the state to do more than a rudimentary visit of Points of Entry crossings. In fact, in some ports in all four border states, there is an assurance that no environmental officials will be inspecting ports of entry for compliance with hazardous waste regulations. Some analysts believe this has led to greater traffic at some ports as truckers seek to avoid compliance with manifest and other hazardous waste requirements.[3]

Table 5. Total Trucks Entering U.S. at U.S. Points of Entry on U.S.-Mexico Border, 1991-99

Table 6. Estimated Number of Port of Entry Investigations, Border Investigators, Warehouse Investigations, Transporter/Transfer Facility Investigations, and Notice of Violations Issued in Border States, FY 98 – 00

C. Social Organization

1. Citizens and Community Organizations

[3] Both Texas and California plan to increase funding and a presence in the border in future years. TNRCC plans to conduct coordinated investigations with EPA in Laredo at approximately 300 warehouse and transfer facilities in FY 01. California's Department of Toxic Substances Control will use additional state funds in FY 00-01 to hire two new inspectors to add to the existing two on the border. This is the first time that state funds have gone directly to border activities. New Mexico had planned to hire a full-time inspector in the border area, but the hired person refused to be relocated to the border. TNRCC August 3, 2000 and Le Pen 2000.

Citizen groups continued to use citizen-suit provisions in both RCRA and EPCRA to attempt to improve waste management practices. However, one recent 1998 Supreme Court decision in Steel Company v. Citizens for a Better Environment curtailed the ability of citizen groups to be granted standing on cases involving past violations of EPCRA. Instead, future citizen suits will only be practical in cases of continuing violations or credible future threats.

Citizens continued to actively oppose new proposed landfills, incinerators and deepwell injection facilities, as well as the continued practice of burning hazardous waste in cement kilns. In general, citizens were successful in preventing new hazardous waste facilities from opening, although many existing "interim" facilities were able to obtain permits, such as the TXI cement plant which burns hazardous wastes in Midlothian, Texas, despite citizen opposition.

New Options for Citizen Involvement in Hazardous Waste Decisions since 1994

In the U.S. citizens are beginning to negotiate directly with companies over pollution prevention, emission reductions and safety issues at the facilities themselves through "Good Neighbor Agreements." Still, there have been other cases where these committees and agreements have not been effective. The key seems to be the ability of the citizens to receive accurate and timely information and the will of the companies to actually implement changes. Government involvement and oversight is also important in carrying out the agreements.

Another new opportunity for citizens living along the border is the CEC's Article 14 and 15 Complaint Submission Process. Despite tremendous difficulties, the CEC process offers citizens a way of attempting to resolve environmental problems when their national government agencies are unresponsive or even hostile. The case of Metales y Derivados is the first example of a hazardous waste issue being accepted by the CEC, forcing Mexico to prepare a response (see section on Mexico).

One new option promised under NAFTA which has not materialized are Transboundary Environmental Impact Assessments (TEIA). Unfortunately, the three countries could not reach agreement and instead have gone forward with voluntary agreements between neighboring states and provinces rather than a trilateral agreement.

2. Hazardous Waste Management Industry

Since 1994, there has been a consolidation of the hazardous waste management industry in the U.S.. For example, in 1998, Chemical Waste Management, which was renamed Waste Management Inc, merged with USA Waste Services Inc., and later divested itself of several international subsidiaries, while keeping its core North American businesses. In addition, the company which operated eight commercial landfills and 3 deep well injection facilities in 1994,

operated only five commercial landfills and 2 deep well injection facilities at the end of 1999 (Waste Management Inc. 2000: 7).

Table 7. Major Commercial Hazardous Waste Combustion and Disposal Facilities Operating in the U.S., 1999

In terms of hazardous waste management, since 1994, a series of mergers led four companies – USPCI, Laidlaw Environmental Services, Rollins Environmental Services and Safety Kleen – to become – at least for a time -- one single company – Safety Kleen. Currently, the company operates four general commercial incinerators, a landfill at one of the incinerators to depose of ash, as well as two specialty incinerators in the U.S. and two liquid hazardous waste incinerators in Canada. There are currently 20 commercial incinerators operating in the U.S. (U.S. EPA, July 1999, Exhibit 2-2). During 1997 and 1998, Safety Kleen closed three commercial incinerators. Safety Kleen also operates eight hazardous waste landfills, including six in the U.S. and two in Canada. Finally, Safety Kleen also owns 10 solvent recycling plants, two fuel blending facilities, and two oil re-refining plants. Safety Kleen estimated it controls 22 % of the off-site industrial waste services industry in North America, generating revenues of nearly $7.4 billion in FY 1999 (Safety Kleen 2000, 13).

In addition, fewer cement kilns are believed to be burning hazardous wastes in 1999 than in 1994 in the U.S.. By 1999, EPA was reporting that only 18 cement kilns were permitted to burn hazardous wastes either under RCRA B permit or interim status (U.S. EPA, July 1999,

Exhibit 2-2). It is believed that the new MACT standard will decrease the number of incinerators and cement kilns burning hazardous wastes, but overall capacity is not expected to change much as those able to meet stricter standards will increase their management of hazardous wastes.

U.S. based companies have continued to look for investment opportunities in Mexico and Canada, due in part to the contraction of the U.S. market, though the actual amount of investment has been relatively small (see Mexico and Canada sections for more details).

B. Waste Disposal Capacity

The U.S. EPA has not required states to conduct Capacity Assurance Plans since 1994. Nonetheless, both the U.S. EPA and most analysts believe that sufficient, and in fact, excess capacity exists in the U.S. to commercially treat hazardous wastes in part because generation of hazardous waste has declined as companies have enacted source-reduction plans (Waste Management Inc. 2000, 7).

In addition, most states have also concluded they have sufficient commercial capacity to manage hazardous wastes. The only major category of waste management where Texas lacks capacity is in zinc recovery (TNRCC March 2000, xiii). Currently, most of these wastes are sent to Mexico for recycling.

C. Waste Generation

In 1997, some 20,305 Large Quantity Generators generated a total of 40,676,075 tons of hazardous waste, a decrease of approximately 500 generators and almost 170 millions tons from the 1995 report (US EPA September 1999, i). Nonetheless, because EPA streamlined reporting requirements, eliminating all wastewaters that are managed in systems regulated by the Clean Water Act rather than RCRA, it is not possible to compare these figures. If such wastewaters are discounted from the 1993 and 1995 report, hazardous waste generation declined between 1993 and 1997, despite an economic boom and higher production in the U.S. In all three years, about 80% of total wastes were generated by the top 50 waste generators, although the percentage of the total declined over time.

Table 8. Hazardous Waste Generators and Generators in the U.S., 1993 – 97

The number of non-storage TSDs also declined over time between 1993 and 1997. The total amount of waste managed off-site differed little between 1993 and 1997 when wastewater is not included. Nonetheless, the management methods, again when discounting wastewater treatment, did change between 1993 and 1997, with a decline in the amount of waste going to both landfills and deepwell injection, and an increase in the amount of waste recovered. The declines are probably the result of regulations which limited the types of waste which could be landfilled or disposed of within land units.

Table 9. Hazardous Waste Managed in the U.S., 1993-1997

Table 10. Tons of RCRA Hazardous Waste Managed Off-site by Year and Management Method

There was an increasing concentration of waste generated and managed in the U.S. states bordering Mexico, while there was a decline in waste generated and managed in the U.S. states bordering Canada. This may represent the general shift in industrial production within the U.S. as states like New York and Michigan lose industry and states such as Texas continue to maintain industrial production. Other states such as New Jersey and California also witnessed a decline in the percentage of hazardous waste generated significantly over the time period, which may also be the result of state legislation designed to encourage pollution prevention. However, in terms of waste managed in off-site facilities, California actually led the nation in 1997, as its commercial facilities increased their receipt of hazardous wastes (U.S. EPA, September 1999, Exhibit 3.11). In addition, the states bordering Canada actually managed more hazardous waste – about 30 percent -- than did the states bordering Mexico, which managed about 25 percent, due in large part to a few large facilities in Michigan, Pennsylvania and Ohio.

When discounting the effects of reporting requirement changes, the total amount of waste generated in Texas did not change much between 1995 and 1997, falling from 72.1 to 69.6 million tons (Corson 2000). Similarly, commercial demand for hazardous waste management from Texas facilities stayed relatively stable between 1989 and 1997, ranging from 711,200

tons to a high of 785,000 tons per year (TNRCC September 1999, 17). In fact, commercial demand has declined in recent years in Texas, even as it has increased in California.

Table 11. Percentage of Hazardous Waste Managed and Generated by State and Region, 1993-1997

Table 12. Quantity of Hazardous Wastes Received Off-Site in Selected States, 1995-1997

D. Transborder Waste Flows, 1993-1997

While record keeping of exports and imports of hazardous waste from the U.S. to Canada and Mexico improved since the passage of NAFTA and the present time, there are still significant gaps in records. For example, because of a lack of resources and difficulty with the Exports database, the EPA only conducted annual assessments of exports between 1993 and 1995 (Table). This assessment shows that exports increased substantially to both Mexico and Canada, particularly waste going to landfills in Canada. Because lead batteries are not required to be reported under RCRA, batteries going to Mexico are not included in these totals. Four Texas generators which ship electric arc furnace dust to Mexico increased exports of hazardous waste to Zinc Nacional in Mexico from 28,458.78 to 38,193.41 tons between 1993 and 1997, believed to be the result of increased production (Corson, 2000).

Table 13. Exports from the U.S. to Canada, Mexico and the Rest of the World, 1993-1995

A similar story is told by looking at the number of export waste streams and waste notices, which have increased over time to both Mexico and Canada. Between 1993 and 1999, the total number of notice of exports increased from 526 to 816 and the total number of waste streams increased from 1085 to 4901. Virtually all of this increase was due to increased notices to export to Canada, although there was an increase in notices and waste streams of exports to Mexico as well (Table).

Table 14. Number of Waste Streams and Waste Notices of Exports, 1993-1999

In 1998, information provided by U.S. exporters showed that 21 facilities in Canada received U.S. hazardous waste, while only one TSD facility in Mexico – Zinc Nacionale – received U.S. hazardous waste. However, two other firms in Mexico – Accumex and Metales Potosí – are believed by U.S. officials to be receiving spent lead batteries for recycling.

Table 15. 1997 and 1998 Consignees in Canada and Mexico Receiving U.S. Hazardous Waste

Limited information on imports of hazardous waste from Canada and Mexico from the WITS database shows a general decline in the number of notices of imports from both Canada and Mexico.

Table 16. Number of Waste Streams and Waste Notices of Imports, 1995-1999

According to HAZTRAKS, imports of RCRA hazardous waste from Mexico increased slightly from 9,437 tons to 11,057 between 1993 and 1997, while imports of total industrial wastes, including both RCRA and non-RCRA wastes, increased from 21,768 tons to 31,709 tons, a significant increase (TNRCC, December 1998, 2). About 3,000 of the tons were imported to two landfills in California owned at the time by Laidlaw and Chemical Waste Management. Using its state tracking system, Texas reported in 1997 that most waste from Mexico went to a Waste Management Inc. incineration facility (3009.5 tons), or was fuel blended (867.27 tons) for later combustion in cement kilns (Corson 2000).

Table 17. Tons of RCRA hazardous waste, total Solid Waste and Number of RCRA Hazardous Waste Manifests received from Mexico, 1993-1997

There are a significant number of maquiladoras reporting waste return to the U.S. in the HAZTRAKS database. For example, approximately 800 companies, or about 40% of all border states maquilas in 1997 are reported as having shipped solid wastes -- which could either be non-hazardous or hazardous --- from Mexico to the U.S. sometime during 1997. However, most of the maquiladoras in the database are from two cities, Ciudad Juárez and Tijuana, and the vast majority of waste from these two cities comes from a handful of maquilas. Not surprisingly, the Ports of Entry at these two cities have the highest amount of inspection and enforcement activity by state government and the best working relations between U.S Customs and state and EPA officials. In addition, because of funding problems, Haztraks is two years

behind schedule, and currently only data through 1997 has been entered into the system. As reported elsewhere, information from the Mexican government shows an increasing trend in waste being exported from Mexico to the U.S.

Table 18. Amount of RCRA Hazardous Waste Shipped to U.S. by Border Cities, 1997

Mexican Case

A. Government Policy

Federal

In 1996, Mexico's Congress approved revisions to the LGEEPA. The revisions to the General Law state that the policy of Mexico is to prevent the generation of hazardous waste, emphasizing minimization policies, recycling and secondary materials recovery.

Major revisions to the LGEEPA related to hazardous waste management include:

*Establishing a system to differentiate the hazardousness of wastes into "high," "medium" and "low," through NOMs (Normas Oficiales Mexicanas), to make them easier to manage.

*Allowed importers and exporters of hazardous waste to obtain a single authorization for the year for shipments of hazardous waste, rather than an authorization for each individual shipment.

*Establishing the possibility of transferring control of management of some "low" hazardous wastes to state governments (non-hazardous wastes have always been subject to state government regulation);

*Allowing disposal of hazardous waste in landfills ONLY in those cases where recycling or secondary materials recovery is not technically or economically feasible and prohibiting the disposal of liquid hazardous wastes in landfills; and

*Prohibiting the import of hazardous materials or wastes that have been banned from production or use in the country of origin.

The Amendments kept the major provisions of the General Law regarding export and import of hazardous wastes, including Article 153 – prohibiting import for final disposal or storage -- and Article 55 – mandating return of hazardous waste by maquiladoras.

Other important new regulations passed between 1994 and 1999 included: creation of a standard involving the management of medical waste; an agreement with the cement industry allowing for incineration of hazardous wastes; creation of a new hazardous waste tracking system; new regulations on reporting industrial accidents; and creation of a voluntary hazardous waste and toxic release reporting program.

Table 19. Government Regulations and Actions regarding Hazardous Waste since 1994

Still, there are major gaps in Mexico's environmental regulations and several proposed standards have yet to be approved.

Table 20. Proposed Standards in Mexico Related to Hazardous Waste, 2000

As a response to the perceived lack of available landfills, Mexico has began promoting the establishment of a series of CIMARIs -- Integrated Centers for Handling, Recycling and Disposal of Hazardous Waste. According to INE, the development of CIMARIs is intended to alleviate the country's lack of disposal facilities, and provide a full range of possibilities for waste treatment and recycling in a few central locations. CIMARIs are being held up as the solution to Mexico's hazardous waste management problems, with the government "assuming an open role of promotion (SEMARNAP 1996, 149)." According to Mexico's official program for hazardous waste management, "an environmental market is an end in and of itself to respond to the necessities of environmental protection and to reinforce the interrelation between environmental policy and economic development. (SEMARNAP 1996, 151)." As of 1998, eight Mexican companies -- most of whom have a U.S. partner -- had been approved by INE as meeting the technological requirements to set up a CIMARI, though the standards have yet to be approved. However, the first company to attempt to open a "CIMARI" failed, due to citizen opposition and irregularities in the approval of an Environmental Impact Assessment.

As part of the process of promoting CIMARIs, INE has also created a "vulnerability atlas" for all of Mexico, including the entire length of the U.S. - Mexico border. The idea was to determine the most appropriate sites for the management, treatment, storage and disposal of hazardous waste. Although the atlas is reported to be complete and was originally intended to produce social consensus on appropriate sites for CIMARIs, it never underwent public review and is only being used as "an instrument of support (Border XXI Working Group, 2000, 3)."

Enforcement activity

PROFEPA continued to inspect, levy fines and close industries; on the other, it attempted to bring more industries into its National Environmental Auditing Program. While the total number of inspections decreased slightly over the time period, the number of industries with significant violations also decreased, suggesting better compliance with environmental regulations. The amount of inspections and compliance rates do not differ significantly between the border and the nation as a whole. Total fines levied against companies totalled $100 million pesos between 1992 and 1997, including $50 million between 1995 and 1997 (PROFEPA 1998, Figure 5). These fines are minuscule by U.S. enforcement standards.

Table 21. Number of Industrial Inspections and Environmental Compliance Rates Over Time, 1994-99

Table 22. Inspections and Compliance Rates, Border States vs. Nation, August 1992 – June 2000

Similarly, the number of companies participating in the Auditing Program increased during the 1994-99 period, which PROFEPA cites as its rationale for reducing the universe of industries it has inspected in recent years. In all, PROFEPA reports that 1,439 facilities have undergone environmental audits, 133 of which have been certified as "Clean Industries".

Table 23. Number of Environmental Audits, 1992 – May 2000

Beginning in 1996, PROFEPA also began promoting a system designed to measure actual compliance with environmental regulations. Known as the ICNAs, the system was first applied in the Mexico City area, and later, in 1998, to the entire nation. According to PROFEPA, the system leads to more detailed inspections. Preliminary data from 1998 to 2000, shows that there was significant non-compliance with both regulations for both hazardous waste generators as well as for hazardous waste service providers and medical management facilities. PROFEPA points out that when data from the environmental auditing program is added, compliance rates improve, and that the vast majority of compliance problems do not involve major environmental violations. Still, the data clearly demonstrates that despite significant effort to better enforce hazardous waste regulations both through inspections and auditing programs, compliance remains low in Mexico, particularly for basic reporting requirements.

Table 24. Average Compliance Rates (ICNA) in Mexico for Hazardous Waste Generators and Management Companies, 1998-2000

Finally, Mexico authorities also began the unpleasant task of identifying illegal waste sites contaminated with hazardous substances. Between 1995 and 1997, PROFEPA identified 166 contaminated sites, more than a third of which were located along the border. Unfortunately, while authorities could order clean-up of several of these sites where existing operators were still in existence, Mexico has no environmental regulations similar to Superfund Laws and has no public funds expressly committed to clean-up functions.

Similarly, PROFEPA also keeps information on the number of industrial accidents. The number of accidents between 1994 and 1999 has remained fairly constant over these six years, with most accidents occurring outside the border region.

Table 25. Abandoned and Illegal Hazardous Waste Sites, 1995-1997

Table 26. Number of Industrial Accidents in Mexico, 1994-1999

B. Social organizations

1. Community and Citizen Groups

Since NAFTA, Mexican citizens, community organizations and environmental organizations have increased their participation and input into decisions regarding management of hazardous wastes. They have also consistently demanded better environmental information from Mexican authorities.

Revisions to the new General Law addressed the possibility for social participation and access to environmental information. For example, under Article 159 bis-3 "Right to Environmental Information," the Secretary of Environment, Natural Resources and Fishing (SEMARNAP) is required to develop a publicly accessible environmental information system. In addition, one of the newest aspects is the obligation of any state, local or federal environmental authority to answer each and every request for environmental information within 20 days, as well as the community's right to present an administrative appeal should their request be denied. However, the law allows the environmental authorities to deny the request for a number of rationales. In the experience of communities and organizations, the ability to both obtain information and win an administrative appeal has been extremely difficult since NAFTA, although access to some types of information has improved.

Community groups and local leaders continued to oppose new landfills in Mexico. For example, in Hermosillo, community groups protested the removal of the waste from the abandoned “Alco Pacifico” battery smelting operator near Tijuana to a Spanish-owned landfill in Hermosillo then called “CYTRAR.” On November 2nd, 1998, INE revoked the licensing permit of CYTRAR, ordering the company to cease operations by November 20 (Jacott 2000, 42). The company is

currently not operating in Mexico. Similarly, Mexican groups, citizens and some political leaders were instrumental in opposing a proposed hazardous waste landfill proposed between Torreón and Saltillo in the State of Coahuila, which has not been approved (see Waste Disposal Industry).

Citizens have also continued to take advantage of provisions in the General Law to register complaints, or denuncias populares with PROFEPA. Many of these have been in the border region. Between 1995 and 1997, citizens filed 17,200 environmental complaints with PROFEPA's state and central offices, a significant increase since 1994. Nevertheless, only 1 percent of these complaints were related to management of hazardous wastes, with the majority involving air emissions and improper forest management (PROFEPA1998, Chapter IV).

Finally, some groups have begun to take advantage of the NAFTA side-agreement provisions through the Commission on Environmental Cooperation. In 1998, the Environmental Health Coalition, a U.S. NGO, and the Comité Ciudadano de Tijuana filed a complaint against the Mexican government for failing to enforce its laws against Metales y Derivados S.A., an abandoned battery smelter which has sat outside Tijuana for six years after Mexican authorities shut it down. In May of 2000, the CEC Council instructed the Secretariat to proceed with a factual record of the case. More recently, a human rights organization in Sonora has submitted a claim with the CEC, alleging that Mexico has failed to enforce environmental laws against a company called Molymex, which processes residues from both U.S. and Mexican companies.

2. The Waste Management Industry.

The hazardous waste management sector grew tremendously between 1992 and 2000 as INE, Mexico's permitting authority, continued to permit a number of treatment, recycling and incineration facilities for both medical hazardous and industrial hazardous waste (see section on Waste Disposal Capacity).

Much of this increase was spurred by the adoption of new policies and standards in Mexico. In 1995, Mexico approved regulations for the treatment and incineration of medical hazardous wastes, which forced hospitals and other medical facilities generating hazardous waste to characterize and treat their wastes or send them off-site to disposal facilities.

In addition, the Mexican government actively promoted the fuel blending of liquid – and in some cases –solid wastes and the subsequent incineration as a means to reuse and manage hazardous wastes in Mexico. Toward this end, Mexican federal authorities began approving cement kilns temporary authorizations back in 1991. However, in March of 1996, authorities signed an agreement with the cement industry to allow burning of hazardous wastes through temporary permits. Thus, all 26 authorizations for cement kilns and in some cases, electrical plants, to burn hazardous wastes are based upon test burns and temporary authorizations, not upon a standard approved by the Mexican government through a public process.

Table 27. Cement Plants which Burned Hazardous Waste in Mexico, 1997

These openings in the hazardous waste industry have led foreign companies to become involved in the Mexican market. As previously mentioned, the leading cement manufacturers in Mexico sought outside technical and financial help from U.S.-based companies to open fuel blending facilities and begin burning hazardous wastes in their kilns. In addition, Chemical Waste Management began providing technical assistance and support for the construction of a new fuel blending plant at RIMSA's hazardous waste landfill in Nuevo León in 1994. The association between the largest hazardous waste management company in Mexico and the largest in the U.S. shows the opportunity that foreign companies see in the Mexican market. Under their agreement, RIMSA also collects and exports wastes contaminated with PCBs to Waste Management Inc. facilities in the U.S.

Similarly, Metalclad's Mexican subsidiary signed an agreement in 1996 with Laidlaw Environmental Services to collect and export PCB contaminated wastes for export to the U.S. Laidlaw operates collection facilities in Mexico which then export the wastes to its facilities in the U.S. These facilities are now owned by a subsidiary of Safety Kleen.. U.S. subsidiary representatives have also served on consultative committees to develop hazardous waste standards in Mexico, influencing the types of regulations developed by the federal authorities.

Foreign and domestic companies have also attempted to open hazardous waste landfills in Mexico since NAFTA, with limited success. In addition to the RIMSA facility, until the end of 1998 a hazardous waste landfill had been operating just 7 kilometers outside Hermosillo,

Sonora. Originally built by the Ford Corporation to dispose of their own hazardous wastes, the Spanish firm TECMED purchased and began operating the hazardous waste landfill in 1994. Last year, the landfill began receiving shipments from Alco-Pacífico, an abandoned lead smelter located just outside of Tijuana. A transportation company, Quemetco Inc., had been discovered violating California state hazardous waste laws in transporting waste from the site into Los Angeles County and a $2.5 million plea bargain agreement was with the Supreme Court of the County of Los Angeles. Subsequently, approximately $2 million was turned over to the Government of Mexico in order to transport the remaining waste from Alco Pacífico to Hermosillo (US EPA 1998, 62-63). However, after citizen opposition and protest and a lawsuit, Mexican authorities revoked the operating permit in 1998 and the Spanish company is no longer operating in Mexico (Jacott 2000, 42).

Table 28. Hazardous Waste Landfills Which Had Operating Permits in Mexico, 1998

Similarly, Metalclad subsidiaries attempted to open hazardous waste landfills in Aguascalientes and San Luis Potosí, but met stiff opposition, including from local the state regulators. In January 1997, Metalclad Corporation filed a Chapter 11 complaint through the International Center for the Settlement of Investment Disputes, an arm of the World Bank, alleging that the Mexican state of San Luis Potosi violated NAFTA's investor right provisions when it prevented the company from opening its 360,000 ton-per-year hazardous waste disposal landfill, in essence "expropriating" its property. Even though the Mexican federal authorities had given an authorization to the site in 1995, state government prevented the landfill from opening by never

issuing land use permits, and declaring the area an environmental reserve. The company sought $90 million in damages. In October of 1997, the company filed its Memorial, and in February of 1998, Mexico responded with its own Memorial. Hearings were held in 1999 (Metalclad Corporation 2000, 3). On August 30, 2000, the three-member tribunal ruled in Metalclad's favor, ordering Mexico to pay $16.7 million in damages for failing to protect the company's rights as an investor. The Chapter 11 decision occurred behind closed doors. In the meantime, however, the company decided to divest itself of its Mexican operations, selling interests in three Mexican-based companies, with plans to sell off its two San Luis Potosi-based companies, Ecosistemas del Potosi and Confinamiento Tecnico de Residuos Industriales (Metalclad 2000, 10).

Finally, in 1997 -- Servicios Ambientales de Coahuila -- proposed building a "CIMARI" just north of the town of General Cepada, Coahuila, between Saltillo and Torreón, near an important water reservoir and migratory bird sanctuary called the Presa de Tulillo. A $70 million joint venture between RACT, a Utah-based management company, and CleanMex, a Tamaulipas company, the landfill and recycling facility now appears stalled due to opposition from farmers, ranchers, residents of Saltillo and Torreón and Mexico's political opposition parties. The site was supported and approved in virtual secrecy by the local municipality and a "preventative study" was approved by INE. After plans for the facility became public, INE declared that a more rigorous environmental impact statement (EIS) would be required in order for a permit to be issued (Jacott 2000, 44).

C Disposal Capacity

Public investment in all solid waste management declined slightly between 1990 and 1996, in large part of the contraction of the economy, although parastatal companies like CFE and PEMEX did invest significant amounts of money in managing hazardous wastes. Similarly, the total amount of money spent by the public sector in environmental protection also declined slightly from 1990 to 1998.

Total 29. Public Investment in Environmental Protection, and Solid Waste Management, 1990-1996 (Thousands of Dollars)

Table 30. Public Expenditure in Environmental Protection as Percentage of Gross Domestic Product, 1990-1998
(Millions of Pesos at Non-Adjusted Prices)

However, since 1996, there has been significant investment in new hazardous waste facilities on the private side. By 2000, INE reports that there were more than 500 facilities which had authorizations to collect, store, recycle, treat, incinerate or landfill hazardous wastes, a huge increase since 1994. About 40% of these facilities were located in one of the six border states, indicating there is substantial infrastructure in this part of the country. In addition, since the 1995

standards requiring treatment and/or incineration of medical waste, more than 56 facilities have been authorized for treatment and incineration of medical waste. There has also been a vast increase in permitted facilities to incinerate hazardous wastes in medical waste incinerators in cement kilns. Unfortunately, the Mexican government has not conducted a public capacity assessment detailing the total capacity or current hazardous waste management of these industries. Under the nation's first attempt at a national Pollutant Release and Transfer Registry –known as the RETC in Mexico – only six hazardous waste management companies even bothered to report any information to Mexican federal authorities (SEMARNAP 1999, Appendix).

Table 30. Geographic Distribution of Hazardous Waste Collection, Storage and Management Facilities in Mexico

Table 31. Increase in Authorized Facilities in Hazardous Waste Management, including Medical Waste, 1992-1999

D. Waste Generation

Between 1994 and 1999 the number of companies which had the potential to generate hazardous wastes increased substantially. For example, the chemical, mining and metallic industries increased their value added manufacturing during the period, while the number of maquiladoras also increased, both along the border and more rapidly in Mexico's interior. Not

only did the total number of plants and employees increase during this period, but the use of raw materials and foreign inputs also increased, meaning that the wastes generated from these inputs had to be exported back to the country of origin as per Mexican law.

Table 32. Value-Added Product of Non-Renewable Manufacturing Industries in Mexico, 1990-1998

(Millons of 1993 pesos)**.**

Table 33. Number of Active Maquiladora Plants by State and Year, 1990-2000

Table 34. Average Monthly Value-Added Production and Imported Inputs of Maquiladora Plants in Mexican Border States

(Millions of Constant 1994 Pesos)

Despite the increase in production in facilities believed to produce large amounts of hazardous waste in Mexico, public data on the amount of hazardous waste generated is extremely poor. INE reported that in 1999, only 13,245 companies in all of Mexico actually reported generating hazardous waste, even though officials believed that more than 100,000 companies have the potential to do so. These industries reported generating 3.3 million tons of hazardous waste in 1999, a total which is far below the 1994 estimate of 8.0 million and the 1997 estimate of 10.0

million. Interestingly, some states actually reported totals above 1994 estimates, showing how compliance with reporting requirements vary widely by state and indicating that INE's estimates may actually be very conservative.

Table 35. Companies which reported hazardous waste generation in Mexico, September 1999

Table 36. Variation between 1994 Estimate of Hazardous Waste Generated in Mexico and 1999 Reported Hazardous Waste Generated in Mexico

In 1998, PROFEPA estimated that there were 28,077 industries in Mexico with the potential to produce hazardous wastes which come under federal jurisdiction (PROFEPA 1998: Table 1), meaning the figures provided by INE in 1999 represent less than half of those who should be reporting hazardous waste generation to federal authorities. The table shows that a large number of the companies which generate hazardous waste in Mexico are relatively small, although most hazardous waste is generated by large industries. Compliance with hazardous waste generation rules are poor across all sizes of companies.

Table 37. Hazardous Waste Generators Under Mexican Federal Jurisdiction: Number of Establishments per Industry

The Mexican government has analyzed and estimated the waste flow that has been reported to it. For example, in 1996, the government estimated that 1.5 million of the 2.0 million tons

reported that year came from manufacturing facilities. Much of this waste consisted of solvents and used oils. The leading industrial producers of hazardous wastes were the chemical, petro-chemical and metal-related industries.

Table 38. Estimates of Hazardous Waste Generated by Sector, 1996

Table 39. Estimated Generation of Hazardous Waste by Sector, 1996

E. Transboundary waste flows.

Waste Imports

Since 1995, the Mexican government has been reporting the import and export of hazardous waste through a computer database which incorporates all of its "Guías Ecológicas," although there is no public information available on where these wastes are actually generated, where the wastes go, what transport companies are used, and who complies adequately with import and export regulations.

Imports

According to information from Mexico's Guias Ecologicas, hazardous wastes imported from the U.S. increased from 1995 to 1999. While detailed information is not available, the majority of

these wastes are electric arc dust containing zinc and other metals recycled in Monterrey at Zinc Nacional. Other imported wastes include empty hazardous waste containers, lead batteries and accumulators.

Table 40. Imports of Hazardous Wastes from the U.S to Mexico, 1995-1999

INE's own evaluation of the importation of hazardous waste is positive as these materials are used for recylcling and recuperation and provide an economic benefit. Mexican civic organizations have detailed a number of environmental and public health problems related to the import of hazardous wastes into Mexico. In addition, there is still uncertainty as to how Mexico will ultimately define "recycling and reuse." Currently, Mexico has not authorized the import of hazardous wastes solvents, oils and paints which can be blended and burned at cement kilns. However, if Mexico were to allow such an import, as some companies have requested, it could significantly increase the import of hazardous wastes into Mexico for their eventual incineration.

Exports

There are two sources of the export of hazardous wastes from Mexico to the U.S.. On the one hand, under Article 153, Fraction VI, maquiladoras and other industries that import raw materials under temporary import rules must reexport the resulting wastes to the country of origin. On the other, some national Mexican companies have also exported hazardous wastes into the U.S., in part because of the lack of capacity to treat hazardous wastes in Mexico.

According to information from Mexico's Guias Ecologicas, maquiladoras exported 33,187 tons of hazardous wastes in 1995, a total that increased to 83,469 tons in 1998. In 1999, INE reported that total declined to 51,704 tons. Nonetheless, this decrease is largely a paper reduction as Mexico developed its new "SIRREP" hazardous waste tracking computer system and changed the reporting requirement for maquiladoras from Guias Ecologicas to an "Aviso de Retorno" or literally, a "Return Warning," in which maquiladoras report their shipments of hazardous wastes five days before they actually ship the waste. INE reported that the leading exports included plastic recipients, inorganic acids, pigments, paints and resins.

Table 41. Exports of Hazardous Wastes by Maquiladoras and National Industry, 1995 –1999

In addition, INE reports that its national industry exported an additional 31,828 tons in 1999, a significant increase from 1995. INE reports that the leading wastes exported were solids containing vanadium pentoxide, used acid batteries and used catalyzers, wastes for which Mexico lacks treatment capacity.

A. Government Policy

Canada -- Federal

The federal government has been gradually moving towards strengthening its role in the international and interprovincial movements of hazardous wastes. This has largely been a result of the need to implement obligations under the Basel Convention, ratified in 1992, and its amendments.

Revisions to CEPA adopted in 1999, grant the federal Minister of the Environment explicit authority to refuse to authorize a waste import or export, even where a province agrees to it, if he or she believes that the waste in question will not be managed in manner that will protect the environment and human health against adverse effects (CEPA 1999, s.185(2)).
The Act also permits the Minister to require that waste exporters to develop and implement plans to reduce or phase-out their export of wastes for final disposal (CEPA 1999, s.188).

The revised CEPA permits the federal government to make regulations regarding emergency prevention, preparedness, response and recovery (CEPA 1999, s.200). However, no regulations have been made under these provisions. The Act also permits emergency plans to be required from facilities manufacturing, processing or otherwise using substances that have been found to be 'toxic' for the purposes of the Act (CEPA 1999, s.199). Similarly, the Act permits the Minister of the Environment to require the development of pollution prevention plans by facilities that process, manufacture or otherwise use substances that are declared 'toxic" for the purposes of the Act (CEPA 1999, s.56). However, no emergency planning or pollution prevention planning requirements have been established to date.

The Federal Minister of the Environment has indicated that development of national standards for "environmentally sound management" for purposes of the implementation of Canada's Basel Convention commitments through CEPA will occur through the Canadian Council of Ministers of the Environment (Anderson March 2000). The Council is made up of the federal, provincial and territorial Ministers of the Environment, and operates on a consensus based decision-making model.

Enforcement activity

As shown in Table 42, the level of enforcement activity by Environment Canada related to the CEPA hazardous waste import/export regulations remained stable between 1994/95 and 1996/97

In October 1997, the Auditor-General of Canada tabled a report in Parliament which raised serious questions about the effectiveness of the federal government's controls on the transboundary movement of hazardous wastes (Auditor-General of Canada 1997). The report focused on imports and exports of wastes to and from Canada.

The Auditor-General concluded that as a result of significant gaps in the areas of prevention, detection and enforcement, and the limited facilities to physically control exports of hazardous wastes at the border, Canada was not in a position to know the extent to which it is living up to its international obligations with regard to preventing illegal traffic at the border. The Auditor-

General made a number of recommendations to improve the situation with respect to regulation of transboundary hazardous waste movements.

The federal government departments and agencies identified in the Audit were reported as having agreed to implement the Auditor-General's recommendations. As shown in Table 42, there was a doubling of the number of inspections related to the regulations between 1996/97 and 1997/98.

Table 42: Environment Canada Enforcement of CEPA Hazardous Waste Import/Export Regulations.

However, in a follow-up report tabled in May 2000, the Commissioner for Environment and Sustainable Development stated that he was “not satisfied” with the progress that federal departments had made in addressing the 1997 findings. The Commissioner concluded that Canada was still not in a position to know the extent to which it was fulfilling its international obligations to prevent illegal traffic of hazardous waste at the border, and that there still was no comprehensive plan to address long-standing and significant gaps in the enforcement of the transboundary hazardous waste movement regulations (Commissioner for Environment and Sustainable Development May 2000, 9-9 -- 9-11).

Provincial

Ontario

Following the 1995 provincial election, the Ontario Ministry of the Environment suffered a 40% cut to its operating budget, and a 42% reduction in staff.[4] In addition the provincial government advanced proposals for the significant weakening of the regulatory regime for hazardous waste in July 1996, January 1997 and November 1998, especially with respect to the "recycling" of hazardous wastes (Ontario Ministry of the Environment and Red Tape Commission). The bulk of these proposed changes have not been implemented to date, largely as a result of a number of incidents waste handling facilities in the province in the late 1990s (Office of the Fire Marshall 1997).[5]

However, major 'reforms' to the approvals process for waste disposal sites have been implemented. Changes to the *Environmental Assessment Act* adopted in 1996[6] removed requirements from the Act that the need for undertakings, and the availability of alternative ways of meeting those needs be considered in the environmental assessment process. The amendments also granted the Minister of the Environment much wider discretion to refuse to grant public hearings with respect to environmental assessments. At the same time, legislation which had provided funding to *bona fide* public interest intervenors in the environmental approvals process was permitted to expire and was not renewed

[4] These figures are for the end of the 1999/00 fiscal year, based on a 1994/95 base year see CIELAP *Ontario's Environment and the 'Common Sense Revolution' A Fifth Year Report (*in progress).

[5] The most prominent of these was a fire at the Plastimet PVC recycling facility in Hamilton, Ontario in July 1997.

In addition, specifically with respect to hazardous waste imports, the provincial Minister of the Environment wrote to his federal counterpart in February 1997, waiving the province's right to review proposed imports under CEPA Hazardous Waste Import/Export Regulations, effectively stating that the province would accept any waste import without review (Lindgren August 1, 1999).

Alberta

Following major expansion in 1992 the government of Alberta decided to permit the Alberta Special Waste Management facility in Swan Hills to receive out of province waste in November 1994 (Feschuk, November 23, 1994).

Enforcement

Provincial environmental law enforcement efforts have been in general decline since the mid 1990's due to the loss of capacity resulting from budgetary reductions. In Ontario, for example, fines for environmental offences fell from over $3million in 1995 to $864,000 in 1998 (Winfield, Figure 1.3). In addition, the province ceased publication of its annual reports on enforcement activities in 1995.

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[6] Bill 76, *The Environmental Assessment and Consultation Improvements Act, 1996.*

B. Social organization

B. Community and Citizen Groups

The ability of community groups and public interest organizations to influence the approvals process for hazardous waste disposal facilities has been significantly weakened by combination of elimination of intervenor funding, and 'streamlined' approvals process, which has greatly reduced for public to intervene in approvals process.

Since 1995 in Ontario for example, major expansions of existing disposal facilities,[7] and the establishment of new facilities[8] have been approved without public hearings. In other cases, new disposal capacity approved without review under environmental assessment legislation.[9] This has severely limited the scope of public interventions where public hearings have been held.

In addition, in some more remote locations, local government and some public support for new disposal capacity has emerged. Examples of such developments have included Swan Hills Alberta, and Kirkland Lake, Ontario. New or expanded hazardous waste disposal facilities have been seen as development opportunities in these economically distressed communities.[10]

[7] Laidlaw Landfill, Sarnia, September 1997.
[8] Taro "non-hazardous" industrial waste landfill in Stoney Creek
[9] For example, the Gary Steacy Dismantling Ltd low-level PCB incinerator in Northumberland County, Ontario, December 1997, and SRBP high-level PCB incinerator in Cornwall Ontario, December 1999.

C. The Waste Management Industry.

The regulatory 'reform' initiatives undertaken by provincial governments from the mid-1990s onwards were clearly intended to address the concerns of industry, including the hazardous waste disposal sector. The Ontario Red Review Tape Commission, for example, has described its proposals to significantly weaken regulatory controls on hazardous waste management as seeking to:

> "address the concerns of business that waste regulations be overhauled to provide consistency and clarity, remove barriers to recycling, and to implement a risk-based approach." (RTC , 65).

Similarly, the Ontario Ministry of the environment's July 1996 *Responsive Environmental Protection* regulatory reform white paper spoke of :

> "providing flexibility and certainty industry needs to ensure jobs and economic growth." (Ontario Ministry of the Environment 1996, 15) and providing "less red tape for the regulated community." (Ontario Ministry of the Environment 1996, 46).

The ability of the industry to influence public policy in this area position may be further strengthened by impact of NAFTA investor-state provisions. Surprisingly the only Canadian

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[10] On Kirkland Lake see "Bennett files application" (editorial), *Northern Daily News*, March 30, 2000.

case brought forward to date under the provisions of Chapter 11 of the Agreement has been a challenge to a ban on the export of PCBs to the United States for disposal put in place by the Government of Canada between November 1995 and February 1997. The case had been brought by S.D. Myers Ltd, a U.S. firm which had sought to import Canadian PCB wastes for destruction (Scoffield, September 1, 1998). The case has yet to be resolved. However, it is possible to envision a chapter 11 challenge to the efforts of a Canadian government to restrict waste imports to a US or Mexican owned disposal facility in Canada, or – as in the case of Metalclad – a challenge to local provincial authority to impede the development of a hazardous waste facility.

C Disposal Capacity

The situation with respect to hazardous waste disposal capacity changed dramatically in Canada since the early 1990s. This began with an expansion of the ASWMC facility in Swan Hills, 1992, followed by the opening of the facility to out of province wastes in November 1994 (Feschuk November 23, 1994).

The relaxed ap

additional landfill, incineration and solidification facilities. The new facilities have tended to be expansions of existing Canadian owned facilities, or new developments by Canadian operators. Some US investment in new disposal capacity has occurred in the past two years as well.

New facilities approved in Ontario since 1995 include the following:

- July 1996: Philip Environmental Services Corporation new Taro East Landfill in Stoney Creek is approved to receive up to 10 million tons of "industrial non-hazardous" waste over a period of 20 years. The facility was subsequently used to dispose of hazardous waste rendered "non-hazardous" though a solidification process at various facilities in Hamilton and Toronto.

- September 1997: A 1.9 million ton expansion of the Laidlaw/Safety-Kleen commercial hazardous waste landfill in Corunna is approved.

- November 1997: The use of a scrap metal smelting furnace by Gary Steacy Dismantling Ltd. is approved for the destruction of low-level PCB wastes in Northumberland County, with a capacity of up to 1.8 million liters of transformer fluids and 700 tons of waste fluorescent light ballast (Environmental Assessment Board December 1997).

- May 1998. A facility to remove PCBs from electrical equipment operated by the US based firm Trans-Cycle Industries Ltd. is approved in Kirkland Lake, Ontario, with an approved capacity of 101,000 tons of waste per year. The facility is approved to receive wastes from all provinces. The facility applied for a permit to receive wastes

from Basel and OCED countries in July 1999. This was denied in December 99 appealed, and the appeal dropped in April 2000.[11]

- November 1999. The use of a modified scrap metal smelting furnace by SRBP Resource Recovery is approved for high level PCB incineration in Cornwall. The facility is approved to receive up to 130 tons of liquid mercaptan residues, 1,250 tons of other mercaptan wastes, and up to 4,380 tons of PCB wastes per year with no restrictions on sources (Environmental Assessment Board November 1, 1999). The approval is currently under appeal to the Ontario cabinet.

Bennett Environmental Inc. announced the development of an incineration facility for the treatment of up to 200,000 tons per year of soil contaminated with chlorinated and non-chlorinated organic compounds in Kirkland Lake in November 1999. The facility, which would receive both Ontario and out of province and out of country wastes, is currently in the approvals process.

Quebec

New disposal capacity in Quebec approved in the past few years has included:

[11] EBR Registry No.IA0E0790.

- October 1997. An incineration facility for the treatment of soil contaminated with chlorinated and non-chlorinated organic compounds to be operated by Bennett Environmental Inc. in St.Ambroise is approved. The facility, with a capacity of 60,000 tons per year, commenced operations in 1998, and receives waste from Canadian and U.S. sources.

- Stablex: recent permit revisions will allow the facility to increase its waste intake from 100,000 to 125,000 tons per year. The facility reports a 49% increase in waste volumes since 1995, with 40% of the wastes handled currently originating in the United States (Stablex Canada 2000).

D. Waste generation

As noted earli

The only other national data available on waste generation is through the National Pollutant Release Inventory (NPRI). The NPRI showed a significant overall increase 22.6% increase in total transfers from 1995-1997. Indeed, reductions in total releases being reported through NPRI are being overwhelmed by these increases in transfers, with the implication that no progress is being made on total waste generation (Environmental Canada 1999, Table 3 and CEC 2000, Table 5-29).

More reliable data available for off-site transfers of hazardous waste through the provincial manifesting system. However, detailed analyses of this data have only been performed for Ontario. This analysis shows a dramatic growth (41.8%) in off-site transfers between 1994 and 1998, the most recent year for which data is available (Yacoumides June 2000, Table 1). This follows period of a close relationship between overall economic activity and waste seen between 1987 and 1993, representing a rate of growth approximately three times the rate of growth in real Gross Domestic Product for the same period (Winfield 1999, Figure 2).

Although a portion of this increase can be accounted for by changes in disposal practices for landfill leachates, the available date also shows 23.8% growth in the generation of wastes from industrial sources as well. This is consistent with NPRI data on off-site transfers showing a 26.1.% increase in transfers to treatment/disposal between 1995-97 (Environmental Canada 1999, Table 29). The growth in transfers from industrial sources has been concentrated in the steel and chemical industries (CEC 2000, Table 4-52).

Quebec

The limited data available through the NPRI shows similar trends for Quebec with a shows 28% increase in off-site transfers to disposal or treatment reported between 1995-1997 (Environmental Canada 1999, Table 31).

E. Transboundary waste flows.

Waste Imports

Data gathered by Environment Canada regarding transboundary waste movements from 1987 to 1999, indicates a dramatic growth in hazardous waste imports, from 129,476 in 1987 to 660,000 in 1999. Imports had remained stable until 1993 and then began to accelerate rapidly from 1994 onwards. Nearly 99% of the imports are to the provinces of Ontario and Quebec, and are almost entirely from the US.

Table 43. Imports of Hazardous Waste from Canada by Province, 1993-1999

Ontario

Environment Canada data indicates that waste imports to Ontario have grown from 52,510 tons in 1991 to 325,000 tons in 1999, with a rapid acceleration occurring after 1993. Analysis of Ontario hazardous waste management manifest data for the 1994-1998 period indicates that the key waste classes involved in the growth are other specified organics (+460%) other specified inorganics (+333%) and aromatic solvents (+265%) (Yacoumides June 2000, Table 37). The largest increases in imports have been to landfill (+257%), processing (e.g. solidification) (+129%) and incineration (+113%) (Yacoumides June 2000,

Table 38). The leading sources of exports to Ontario are the states of Michigan, New York and Ohio (Yacoumides June 2000, Table 30).

The key facilities receiving imports include the Laidlaw/Safety-Kleen landfill and incineration facility in Corunna, the Safety-Kleen oil and solvent recovery facility in Breslau, and the Philip Environmental Services facilities in Hamilton and Toronto (CEC 2000, Tables 4-59 and 4-60 and Yacoumides June 2000, Table 31).

Quebec

Imports to Quebec grew from only 75,000 in 1993 to 333,000 by 1999. While in past years, more than 70% of the waste has gone to recycling facilities, in 1999, more than 45% went to disposal facilities, indicating a significant growth in landfilling and incineration. The key facilities receiving imports include the Stablex solidification facility in Blainville and the Laidlaw/Safety-Kleen incineration facility in Mercier (CEC 2000, Tables 4-59 and 4-60 and Yacoumides June 2000, Table 31).

Exports

Hazardous waste exports from Canada have stabilized at approximately the same time that waste imports began to accelerate, after a period of growth in the late 1980s and early

1990s. Exports grew from 230,000 to 280,000 tons between 1993 and 1998, before declining to about 250,000 tons in 1999. Hazardous exports from Canada originate mainly from Ontario and Quebec, although Manitoba and British Colombia also export a significant amount. Virtually all of the waste exported from Canada is sent to the US.

Table 44. Exports of Hazardous Waste from Canada by Province, 1993-1999

Summary of Post-1994 Case

Hazardous waste generation, management, shipments and governmental policies have undergone significant changes since 1994 in all three countries.

In the U.S. regulatory controls on hazardous waste disposal have been strengthened with new listings of waste and new controls on landfill disposal and incineration. The total amount of hazardous wastes generated and managed is generally thought to have decreased slighty. However, there have been significant regional variations with this trend, with waste generation in states in the Canada-US border region declining, while waste generation has increased among the southern border states. There has been little growth in hazardous waste disposal capacity, and the industry has been undergone a substantial consolidation. The US still has limited data on imports and exports of hazardous waste and there is little inspection or enforcement of transboundary shipments of hazardous wastes.

The changes in Mexico and Canada have been more significant. In Mexico regulatory controls on hazardous waste management have been strengthened in some areas. However, this has been accompanied by a dramatic expansion of the number of approved hazardous waste disposal facilities, particularly since 1998, with substantial foreign investment in the sector. In addition, hazardous waste generation is thought to have continued to rise, both nationally and in the border region, although low compliance with reporting requirements make it difficult to assess whether more waste is being generated and to assure that waste is being adequately managed. Waste imports from the US for "treatment" and "recycling" have increased, as have exports of wastes, although exports remain far below the levels that would be expected under the waste return requirements of the maquiladora program.

Perhaps the most dramatic changes, however, have been seen in Canada. Provincial regulatory requirements regarding the management of hazardous wastes, and the approval of disposal facilities have been significantly weakened, particularly in Ontario and Quebec. These developments have been accompanied by a significant growth in the domestic generation of wastes, particularly from the steel and chemical industries. There has also been a very sharp increase of imports of wastes to Ontario and Quebec from the US for disposal, while waste exports have remained stable.

Relaxed approvals requirements have facilitated the establishment of new disposal capacity in Ontario and Quebec, and additional expansions are planned. The existence of weaker requirements regarding disposal than those in the United States appear to be the overriding

factor in the growth in waste imports into Canada. Provincial governments have explicitly identified trade liberalization as a driver of their "reform" of the regulatory regime, and as a constraint on their ability to adopt higher environmental standards.

D. Assessment/Explanation

A. Overview/Assessment

The previous chapter showed significant change within each country in terms of the generation, management and shipments of hazardous waste since 1994. This chapter attempts to analyze the data presented in light of the two questions posed at the outset of the paper:

A. Are companies in the manufacturing or hazardous waste management sectors relocating or are they sending hazardous wastes to other areas to take advantage of less stringent hazardous waste regulations or enforcement?

B. Is trade and investment liberalization concentrating economic activity (in both manufacturing and the hazardous waste management industry) in areas where it takes place more efficiently, or conversely, where ecological stress is already acute such as the U.S. - Mexico border region and the U.S. Canada-Border Region?

B. Explanation of Changes in Waste Flows

First of all, there have been significant increases in hazardous waste exports from the U.S. to Canada and Mexico and from Mexico to the U.S., while exports from Canada to the U.S. have remained relatively stable. One possible explanation – examined below – is that exporters are taking advantage of looser regulations and lower costs in some countries to export hazardous wastes.

1. U.S. to CANADA

A number of possible explanations are available regarding the dramatic shifts patterns of waste flows following 1993/94 as imports to Canada rose substantially.

- Shifts in exchange rates.

It has been suggested that the increase in waste flows into Canada for disposal can be explained as a result of the decline of the value of the Canadian dollar relative to the US dollar, making disposal in Canada a less expensive option.

An examination of waste imports relative to the value of the Canadian and US dollars, as shown in Table 46, and plotted in Figure 1 indicates that the point at which waste imports began to grow dramatically (1993/94) shows a weak correlation with a decline in the value of the Canadian dollar relative to the US dollar between 1991 and 1994. However subsequent

increases in the value of the Canadian dollar to not appear to have affected waste imports. Earlier rises (1987-89) in imports correlate weakly with increases in the value of the dollar.

Figure 1: Hazardous Waste Imports to Canada and Canadian/US Dollar Exchange Rates.

Changes in the relative values of the US and Canadian dollars do not appear to have had any noticeable impact on Canadian waste exports. These would be expected to decline in low Canadian dollar situations, due to the increased costs of out-of-country disposal.

Table 46: Spot Exchange Rate Canadian $ / US $ based on march 31's exchange rates for each year

These figures lead to the conclusion that there is no clear relationship between the relative values of the Canadian and US dollars and the rise in waste imports. At best there is a weak correlation with decline in dollar and take-off in waste imports, but data inconsistent, doesn't suggest extreme price sensitivity.

Although specific data on waste disposal pricing is difficult to obtain, it has been suggested anecdotally that was disposal costs in Canada may be between one half and one-tenth those in the US, due to higher US treatment standards (Lindgren August 1, 1999). This difference in base prices for disposal costs are likely sufficiently large to be unaffected by shifts in exchange rates.

- Economic Growth in the United States.

Real GDP in the United States has undergone steady growth at a rate of approximately 2.3% per year since the early 1990s (U.S. Department of Commerce 1998). This is not sufficient to account for the increase in waste exports to Canada from the early 1990s and the present.

- Growth in US Waste Generation

Data is available through the RCRA Biennial reporting program for total US hazardous waste generation by state. However, this data suffers from some significant limitations, particularly due to changes to reporting requirements for the 1997 reporting year. As shown in Table 47 with the exception of Ohio, which shows a slight increase, total waste generation in the key exporting states to Canada (Michigan, New York and Ohio), reported under the RCRA program suggests a decline in hazardous waste generation in these states. Therefore increases in waste generation by US sources cannot account for the increase in waste imports into Canada. Overall, waste sent to off-site facilities in these states remained stable between 1995 and 1997, but with Michigan accounting for a large decrease and Ohio and New York a slight increase (see Table 12).

Table 47:Hazardous Waste Generation in Key Exporting States 1991-1997

- Domestic policy changes in US (RCRA Rule implementation)

Following amendments to the *Resource Conservation and Recovery Act* in 1984, USEPA has been moving to implement new standards for hazardous waste generators and treatment, storage and disposal facilities. This has included biennial registration and reporting requirements, storage and emergency preparedness requirements, a ban on the land disposal of untreated hazardous wastes, and legal standards for waste containers, storage tanks, containment buildings, land treatment units, surface impoundments and waste piles. In addition, new emission and operating standards for hazardous waste incinerators, boilers and industrial furnaces, were adopted under RCRA and the *Clean Air Act* in July 1999, although the impacts are only beginning to be felt by the industry.

No comparable standards for hazardous waste generators, and treatment, storage and disposal facilities exist in Canada at either the federal or provincial levels. The existing provincial regimes were largely implemented prior to the adoption of the post 1984 RCRA rules, and the federal requirements related to transboundary waste movement are procedural rather than substantive in character.

Figure 2: Hazardous Waste Management Regulation in Ontario and the United States

Differences in Canadian and US rules in this area have been consistently identified by US waste generators, treatment and disposal service providers and regulators in commentary on the growth in waste imports (Mittelstaedt September 27, 1999), and have been acknowledged as a significant factor by the Ontario (Mittelstaedt September 18, 1999) and Canadian federal Ministers of the Environment (Mittelstaedt March 22, 2000) and the Canadian Environmental Industry Association (Mittelstaedt February 28, 2000).

In particular, adoption of Land Disposal Restrictions (LDR) rules since 1994 have forced waste generators to not only treat constituent wastes but the underlying wastes to meet treatment standards. It is believed that these "underlying" constituent treatment requirements and other new LDR rules are driving generators to send wastes to Canada rather than meet such standards. As mentioned, in particular there has been a large drop in waste sent off-site to disposal facilities in Michigan between 1995 and 1997, which may in part account for an increase in US exports to Canada (see Table 12).

- Trade liberalization

i) Direct Impacts

The direct impact of the provisions of NAFTA and trade liberalization on waste flows and government policies in this area has been limited. However, two Chapter 11 cases have been

brought forward with respect to hazardous waste management, the S.D.Myers PCB export restrictions case in Canada, and the Metalclad case in Mexico. The recent ruling favorable to Metalclad against the government of Mexico may have a chilling effect on new regulations and enforcement of existing regulations, particularly at the provincial (or state) and local level.

Issues related to potential restrictions on governments' freedom of action with respect to hazardous waste policy as a result of the provisions of NAFTA were raised during the Government of Canada deliberations regarding its 1995 PCB export ban (Scoffield October 31, 1998). In addition, when data showing the dramatic growth in hazardous waste imports into Ontario was first released to the public in March 1999, the Ontario Minister of the Environment stated that he could do nothing to reduce the flow as

> "we have a free trade agreement (NAFTA) that limits us." (The Hon. N.Sterling, Ontario Minister of the Environment, as cited in B.McAndrew April 18, 1999).

Similarly, his successor stated in August 1999 that he was "handcuffed" by the NAFTA with respect to waste imports (The Hon. T.Clement, Ontario Minister of the Environment, as cited in Lindgren August 1, 1999).

ii) Indirect impacts

The process to trade liberalization has been explicitly identified by Canadian Provincial governments as a driver of their environmental 'regulatory' reform policies. Ontario's Red Tape Commission, for example, has stated that:

> "In today's global environment, business must minimize their expenditures in order to remain competitive with our trading partners."

> "These (regulatory) requirements simply increase the costs of doing business. Therefore getting rid of and avoiding unnecessary and duplicative regulatory requirements can create a competitive advantage, particularly in an open economy such as Ontario's that depends on exports" (Red Tape Commission, 3).

The Ontario Ministry of the Environment cast its regulatory 'reform' proposals in a similar light:

> "As capital becomes increasingly mobile and reliant on high technology infrastructure, we must continually find new ways to make environmental management clear, flexible and predictable; (Ontario Ministry of the Environment, July 1996, 13).

> "current regulatory requirements that may function as non-tariff barriers need to be brought into line with current practices." (Ontario Ministry of the Environment, July 1996, 13).

> "a reformed system of environmental regulation will contribute to a competitive business climate." (Ontario Ministry of the Environment, July 1996, 13).

Trade liberalization has, therefore been both identified by Canadian governments as a barrier to the strengthening of environmental protection requirements, and as a driver of policy initiatives which have had the effect of weakening environmental laws and regulations.

2. U.S. to Mexico

Although there are problems with the data in the U.S. for most years, data from Texas, from the U.S. and from the Mexican government confirm that hazardous waste exports from the US to Mexico have increased significantly since NAFTA, perhaps nearly doubling. The majority of the waste exported by the U.S. to Mexico are emission control dust containing zinc and other metals from the U.S. steel and metal-making industry. There are therefore several possibilities as to why exports to Mexico have increased since NAFTA:

*Changes in regulations and Land Disposal Requirements;
*Lack of capacity/price differentials for metal recovery in U.S.;
*Changes in technology and the amount of waste generated in Steel Industry;
*Trade Liberalization

a. Changes in Regulations

New regulations adopted in the U.S. favor treatment technologies over landfilling. All of the waste being sent to Mexico are to battery reclamation and high temperature metal recovery plants with technologies similar to those offered in the U.S.. In fact, by law, no hazardous waste can be sent to Mexico for final disposal. In the U.S., after undergoing metal recovery, a small amount of the waste is left over and sent to landfills. It is a slight, but not likely, possibility that given a choice of treating metal-bearing wastes to certain standards and then having to landfill them, treating them in Mexico was preferred. Still, regulatory controls have had little bearing on this waste.

b. Lack of Capacity and Price Differentials

According to the 1994 CAP report, there was plenty of capacity in 1994 for the U.S. to treat and recycle off-site metal wastes nationwide. In fact, throughout the 1990s, firms like Envirosafe of Ohio, Hoursehead Resource Development in Pennsylvania, and Laidlaw in South Carolina have continued to operate high temperature metal recovery facilities to treat and recover thousands of tons of Electric Arc Dust (EAD). Nonetheless, in certain states such as Texas, analysis has shown there is a lack of capacity for the treatment and recycling of metal wastes, with 2002 demand outstripping available capacity by 130,000 tons (TNRCC 2000, xiii). This lack of local capacity may have led firms like Chapparal Steel in Texas to export a large amount of their waste to Mexico during the 1990s, particularly since major metal recovery facilities in the U.S are located in Pennsylvania and South Carolina.

Although specific data on waste disposal pricing is difficult to obtain in Mexico, a 1996 study found that costs were between half and a fourth as much in Mexico to commercially dispose of hazardous wastes as in the U.S. (SEMARNAP 1996: Chapter 2). Again, given a choice between sending wastes to U.S. facilities or Mexican facilities for similar treatment, price differentials, combined with transport costs, could have been a factor in the increased exports of hazardous waste to Mexico over the 1990s.

c. Changes in Technology and Amount of Waste Generated

The most likely explanation for an increase in hazardous waste being exported to Mexico is changes within the steel industry itself. Since the early 1990s, large integrated steel mills like Integrated Steel, USX and Bethlehem Steel produce relatively less steel in the U.S., while companies like Nucor, which use milli-mills to produce steel, have increased production. However, these milli-mills produce higher amounts of Electric Arc Dust in their production process, leading to higher amounts of wastes generated. Thus, while integrated steel manufacturers have produced the same or less amount of hazardous wastes – particularly as some companies have closed up shop -- milli-mills have increased their production and generation of hazardous wastes. In 1997, some of these milli-mills shipped hazardous waste to Mexico for the first time.

Table 48. Tons of Electric Arc Dust Hazardous Waste (Code K061) Produced by Selected Steel Mills and Tons Shipped to Mexico, 1993 -97

C. Trade Liberalization

The waste being exported to Mexico has gone to the same firms in Mexico over the last six years. However, certain firms which began to export for the first time to Mexico in 1997 may have felt more comfortable sending hazardous wastes abroad due to Mexico's new image as a "free trade" country. Still, because NAFTA simply reaffirms the prominence of the La Paz Agreement and its annexes and Mexican law continues to prohibit the import of hazardous wastes for disposal, NAFTA and "trade liberalization" does not explain the increase in exports from the US to Mexico.

3. Mexico to U.S. Hazardous Waste Flow

There are significant differences between the U.S. and Mexico in terms of how much waste they report as flowing from Mexico to the U.S. over the 1990s.[12] However, the total amount does appear to be increasing. There are three possible reasons for this increase. First, as detailed

[12] Recently, the EPA, with help from INE, claims it was able to document the reasons for the differences in numbers between the two countries. The EPA compared initial data between the two countries in 1997 -- 50,811 reported in Mexico as compared to 11,057 reported by the U.S. According to the EPA analysis, 68 percent of the hazardous waste reported to be exported by companies in Mexico to the United States were actually --by U.S. regulations -- defined as non-hazardous industrial wastes. Another 29% of the difference was due to a reporting error, when one company reported a product intended for use in the United States as a hazardous waste. Therefore, the unexplained difference is only very minor, about 622 tons in all.[12] Still, it

extensively in this report and elsewhere there are simply more maquiladoras and industrial production in Mexico. Second, a lack of capacity in Mexico for certain types of treatment such as landfilling and recycling of catalytic converters makes export to the U.S. the best option. Finally, there may be better compliance with hazardous waste repatriation requirements as PROFEPA has increased inspections. Nonetheless, because the number of maquiladoras near the border has nearly doubled since 1994, and the percentage of foreign inputs has remained constant, the total amount of wastes reported as being imported still suggests a lack of compliance with Mexican regulations. In fact, this report suggests that hazardous waste exports should be considerably higher than reported.

Trade liberalization itself does not appear to be directly influencing the flow – except in the sense that investment in Mexico has increased – and is instead most directly related to the requirements under La Paz and Mexican environmental law that maquiladoras return hazardous wastes to the country from which raw materials were imported. However, because of changes introduced under NAFTA's Articles 303 and 304 under NAFTA which reduce the benefits of being a maquiladora, it is possible that many maquiladoras may decide to nationalize in order to escape the repatriation requirements. Thus, both inadequate compliance with reporting and repatriation requirements – and perhaps inadequate enforcement on the part of Mexican authorities – as well as the future possibility of a nationalization of the maquiladora industry -- could allow many companies to escape these regulations in a "liberalized" free trade zone. This

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should be noted that the exercise only took into account the 50,811 tons Mexico initially reported, not the 76,808 tons finally reported.

might have the effect of actually decreasing exports from Mexico to the U.S. even as hazardous waste capacity in Mexico increases.

D. Economic Concentration

1. U.S.-Mexico Border Region

This report found that there is an ongoing concentration of economic activity, including hazardous waste generation, in both the northern Mexico and southern U.S. border regions. In terms of national percentage, the percentage of waste being generated and managed both on-site and off-site at commercial facilities has grown in U.S. border states like Texas and California. In the U.S., in general, enforcement rates of on and off-site facilities were superior in the northern border region, compared with the southern region during the 1990s, suggesting a regional advantage to treating wastes there.

In Mexico, the number of hazardous waste management facilities in the border states has increased more than the nation as a whole – about 40% of all facilities. In addition, while the percentage of maquiladoras located in the northern border states declined overall, the total number continued to increase at an exponential rate, nearly doubling over six years. There was no evidence that any of these maquilas were using more local inputs, meaning hazardous waste was still being generated from U.S. raw materials. While low reporting by hazardous waste generators make it difficult to assess how much hazardous waste is being generated, the report

found it very likely that the generation of hazardous waste is increasing in the northern border states.

While ecological stresses continue to plague the Mexican northern border region because of this economic concentration – as evidenced by the high number of abandoned waste sites and industrial accidents there – whether it is "efficient" for more TSDs to locate in the northern border to more adequately handle this waste or whether it leads to increased stress is difficult to judge given the limited information. The Mexican government as a policy has promoted the creation of an off-site hazardous waste management infrastructure as the means to solve Mexico's mismanagement problems. It has done this in some cases through extra-official policies such as authorizations to burn hazardous wastes at cement kilns without adequate standards, spurred on by significant pressure and influence by national and international companies as well as by announcing the need to develop CIMARIs, although it still has not developed a specific standard for such facilities. This open courting of the hazardous waste management industry has led to a number of companies attempting to open landfills in Mexico, all of which have failed due to failure to meet basic environmental assurances and citizen opposition. The recent Chapter 11 ruling in favor of Metalclad, however, may impede the desire for further regulations at the state or federal level.

There is significant concern that the presence of this new infrastructure in the context of free trade will increase the incentive for U.S. companies to export hazardous wastes to TSDs in Mexico, where costs are cheaper and regulations, reporting requirements and enforcement are

less strict. In particular, depending upon how “reuse” and “recycle” is interpreted, significant amounts of U.S. liquid hazardous waste could be exported to Mexico for incineration in cement kilns under a less rigid regulatory framework. This would significantly increase stress on this region.

2. U.S. –Canada Border Region

While hazardous waste generation declined and commercial management of hazardous wastes remained stable in the U.S northern region, in Canada, both generation and disposal capacity increased in border states like Ontario and Quebec. These facilities, as already mentioned, took more hazardous waste from the U.S., likely increasing ecological stress due to increased transport of hazardous wastes. Again, it is difficult to judge whether it is more efficient for the hazardous waste industry to “concentrate” its facilities in southern Canada, but from a public health and environmental perspective, such concentration is counterproductive to the attempt to manage and reduce hazardous wastes on-site, particularly with improper enforcement and inspection regulations at Points of Entry.

E. Summary and Conclusions

This paper approached the issue of the impacts of trade liberalization on hazardous waste management in North America in four steps. First, a pre-NAFTA 'base case" with respect to government policies, the roles of non-governmental actors, disposal capacity, waste generation and disposal, and transboundary waste traffic was established for each country, which is presented in Appendix A. Secondly, the changes introduced through NAFTA and its institutions were described. Third, the changes with respect to government policies, waste generation, transboundary movement and disposal in each NAFTA country since 1994 were outlined. Fourth, possible explanations for these changes, including the impacts of trade liberalization, and other factors were reviewed and assessed.

This paper sought to answer two questions with respect to environmental effects of NAFTA with respect to the management of hazardous wastes:

- Is trade and investment liberalization concentrating economic activity in the hazardous waste management industry in areas where it takes place more efficiently, or conversely, where ecological stress is already acute such as the U.S. - Mexico border region and the U.S. Canada-Border Region? and

- Are companies in the manufacturing or hazardous waste management sectors relocating or are they sending hazardous wastes to other areas to take advantage of less stringent hazardous waste regulations or enforcement?

With respect to the first question, the available data indicates an ongoing concentration of economic activity, including hazardous waste generation and management in the US-Mexico Border region. This is evidenced by the continued concentration of generation and increase in off-site waste management activities in US border states, the concentration of waste collection, storage and management facilities in Mexican border states, and steady growth of active maquiladora plants in the border region. While is has not been possible in this report that this concentration has increased "stress" over "efficiency" – particularly has hazardous waste data is limited in Mexico – there is significant concern that off-site management of U.S. and Mexican wastes in Mexico will increase ecological stress.

The situation with respect to the Canada-US border region is less clear. Waste generation in key US border states has been in decline. However, waste generation in Ontario and Quebec has been increasing significantly, particularly in the steel and chemical industries, which are concentrated in the border region. In addition, despite the decline in waste generation among the US border states, there has been a dramatic growth in US waste exports to Ontario and Quebec and, in the context of a weakened regulatory environment, a significant increase in disposal capacity in those provinces.

Differences in regulatory requirements related to hazardous waste disposal, specifically the existence of less stringent standards in Ontario and Quebec have been the key factor in the increase in US hazardous waste exports to Canada. Similarly, the expansion of disposal

capacity in these provinces is largely intended to serve the US market, although the bulk of the investments in this capacity is Canadian in origin.

The ban on imports of hazardous wastes for final disposal into Mexico limits the economic incentive for the establishment of disposal capacity to deal with imported wastes to take advantage of differences in the regulatory and enforcement regime between Mexico and the US. However, there has been significant US investment in Mexican capacity for the disposal of domestically generated wastes, with the market for these services being driven by stronger disposal requirements in Mexico in some cases, as well as "temporary" authorizations without publicly-approved standards in others.

Significant gaps exist in the systems for tracking hazardous waste generation and disposal in all three countries. Reliable data on waste generation in Canada and Mexico is extremely limited, and the reliability of the data regarding transboundary waste movements among the three countries has been seriously questioned. Tracking of transboundary waste movements from "cradle to grave" when the "cradle" is in one country and the "grave" in another is almost impossible.

More broadly, while the process of trade liberalization may initially have been a driver for the establishment of a more stringent regulatory regime in Mexico, it has also been explicitly referenced as a factor in the weakening of environmental protection regimes by Canadian governments undertaking such "reforms." The NAFTA trade rules have also been identified as

a constraint on their ability to adopt higher standards to protect human health and the environment. The outcomes of NAFTA Chapter 11 complaints seen in such cases at the ban on MMT in Canada and the Metalclad case in Mexico seem likely to reinforce these directions to the detriment of the health, safety and environment of the citizens of all three NAFTA countries.

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The Generation and Management of Hazardous Wastes and Transboundary Hazardous Waste Shipments between Mexico, Canada and the United States, 1990-2000

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APPENDIX A: Pre-1994 Base Cases

The United States

A. Government Policy

A. Introduction

Before substantial state and federal regulation of waste began in the mid 1970s in the U.S., most industrial waste was disposed of in landfills, stored in surface impoundments such as lagoons or pits, discharged into surface waters with little or no treatment, or burned. Mismanagement of these wastes was common, resulting in polluted ground water, streams, lakes and rivers as well as damage to wildlife and vegetation and public health (US EPA November 1986, 1). Today, three major federal laws guide management of hazardous and other industrial waste:

- Resource Conservation and Recovery Act (RCRA) of 1976. As re-authorized in 1980 and 1984 by the Hazardous and Solid Waste Amendments, this federal law creates a step-by-step management approach restricting and controlling the treatment, storage and disposal of hazardous waste; mandates a permitting system to assure the safe management of all hazardous waste; and

implements a system to track hazardous waste as it moves "cradle-to-grave," from the point of generation to disposal.

- Safe Drinking Water Act of 1974, amended in 1986 and 1996. This act, along with RCRA, protects ground water sources of potable water, and regulates the underground and deepwell injection of industrial and hazardous wastes;
- CERCLA, the Comprehensive Emergency Response, Compensation and Liability Act of 1980, amended in 1986 as the Superfund Amendment and Reauthorization Act (SARA). This federal law created a $1.6 billion "Superfund" to address spills of hazardous waste and clean up of old, abandoned hazardous waste sites, which was later increased to $13.6 million. Title III of SARA, the Emergency Planning and Community-Right-to-Know Act of 1986, required major industries to report releases, transfers and recycling of toxic chemicals to the Environmental Protection Agency as part of the Toxics Release Inventory Program.

Other federal laws which relate to hazardous waste include the 1976 Hazardous Material Transportation Act, implemented by the U.S. Department of Transportation, the Federal Clean Air Act, which regulates the emissions of hazardous substances into the air, the Clean Water Act – which regulates the discharge of pollutants into surface waters and sewers -- and the Toxics Substances and Control Act, which regulates the disposal of PCBs and several other toxic compounds.

In addition to federal regulations, most states have adopted their own laws to manage hazardous waste. Some 44 of 50 states have been delegated the RCRA program by the EPA, although the EPA continues to oversee the program and be involved in compliance and enforcement activities.

B. Regulations and enforcement of hazardous waste at generation

All manufacturers who produce hazardous wastes are subject to a variety of state and federal requirements for the proper management, transport and reporting of hazardous wastes. First of all, manufacturers are

required to take detailed analysis of their waste to determine if their waste is considered hazardous under RCRA regulations. Most RCRA hazardous wastes must be treated in a TSD RCRA permitted or interim facility, whether on or off-site. Virtually all hazardous waste must be treated prior to land disposal. Under the 1984 amendments to RCRA, Congress required the U.S. Environmental Protection Agency (hereafter EPA) to establish treatment standards for all waste identified as hazardous in 1984 by May 1990, although a two-year variance was allowed for certain wastes (TNRCC March 2000: 12). Congress also required EPA to establish standards for "newly-identified" hazardous wastes within six months after identification, a requirement the EPA failed to meet.

In addition, all manufacturers identified as large quantity generators (LQG)[13] must report the amount of hazardous waste they generate every two years, information which is published every two years by the U.S. EPA. Some state-defined thresholds for large quantity generators are lower than the federal definitions.

3. Hazardous Waste Tracking Systems

Shipments Within U.S. Borders

Under RCRA's cradle-to-grave system, all generators must prepare a "manifest" which includes information on the waste, shipper and facility which will handle the waste for any RCRA Subtitle C defined hazardous waste sent off-site. RCRA hazardous waste can only be delivered to a treatment, storage or disposal (TSD) facility having either a RCRA permit or interim status under RCRA. Once the waste is received, the TSD must note any discrepancies between the manifest and the shipment, send a copy to both the shipper and generator within 30 days and keep a copy of the manifest on-site for at least three years (40 CFR 264.71). In

[13] The federal criteria for a large quantity generator is the following:
The generator generated in any single month 1,000 kg (1.1 tons) or more of RCRA hazardous waste; or
The generator generated in any single month, or accumulated at any single time, more than 1 kg. . of acute RCRA acute hazardous waste; or
The generator generated, or accumulated, at any time, more than 100 kg of spill cleanup material contaminated with RCRA acute hazardous waste.

addition, many states have more inclusive definitions of hazardous waste and have developed their own hazardous waste tracking systems (CEC 1999: 14).

Shipments across U.S. Borders

Three federal laws and two international agreements cover tracking and enforcement of transboundary movements of hazardous wastes between the NAFTA countries. The Federal laws include:

*the 1976 RCRA as amended and regulations pursuant contained in 40CFR Part 260;

*the 1974 Hazardous Materials Transportation Act (HMTA) and its regulations; and

*the 1976 Toxic Substances Control Act (TCSA) as amended and its regulations in 40 CFR 761.

International agreements have been reached with Canada under the *1986 Canada-US Agreement on the Transboundary Movement of Hazardous Wastes*, and with Mexico, under the 1983 *U.S.-Mexico Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area* (the La Paz Agreement). In 1986, the U.S. and Mexico adopted Annex III of the La Paz Agreement, addressing the transboundary movement of hazardous wastes between the two countries.

While RCRA, implemented by EPA, and HMTA, implemented by the Department of Transportation, and their regulations establish most of the regulations for shipments of hazardous wastes across borders, TCSA provides the framework for the transport of PCB wastes. Prior to 1996, imports of PCBs were only allowed at concentrations less than 50 parts per million.

All exporters must submit a Notification of Intent to Export (NOI) to the EPA (40 CFR Part 262.52). In addition, all primary exporters – both shippers and generators -- must file with EPA a report by March 1

summarizing the hazardous waste exported during the previous year. Information from notices of intent to export and consents and from annual reports and manifests are contained in EPA's EXPORTS database.

TSD facilities which import hazardous waste must notify the EPA regional administrator at least four weeks in advance of the expected shipment, although subsequent notification is not required if it is for the same type of waste. In addition, the TSD must pre-file the manifest form with U.S. Customs officials at the appropriate Port of Entry.

Under the bilateral agreements, Mexico and Canada must pre-notify the U.S. of any shipments of waste going to a U.S. facility and receive approval. However, because the U.S. is obligated under the La Paz agreement to accept hazardous and other wastes from maquiladoras, no official approval is needed, although notification still applies. There was virtually no information on imports of wastes before 1995.

In addition to the Imports and Exports databases, the U.S. and Mexico agreed in 1990 to develop a database to track hazardous wastes between the two countries. In October of 1992, the two countries announced the development of Haztraks (Hazardous Waste Tracking System). In the early 1990s, Haztraks was jointly run by EPA's Region VI and IX, housed at Region VI in Dallas. Unfortunately, because of a failure of coordination between the two governments, Haztraks has included no or little information on exports from the U.S. to Mexico, and information on imports from Mexico has significant data gaps, detailed extensively in other reports (Jacott 2000: 29-31).

C. Regulations of Hazardous Waste Management Facilities

Any Treatment, Storage and Disposal facility (TSD) treating or disposing of hazardous waste must obtain a RCRA permit from either EPA or the authorized state and meet certain operating, siting and design standards (Some facilities are allowed to operate under "interim" status until a final permit has been issued.) RCRA also:

D. prohibits liquid hazardous waste from hazardous waste land disposal facilities;

E. bans and/or restricts untreated solid hazardous wastes from being disposed at land disposal facilities:

F. prescribes landfill operating standards;

G. imposes financial and liability insurance obligations on TSD facilities for bodily and property damage;

H. provides for a closure and post-closure financial assurance (40 CFR 264.140 (b)) as well as clean-up procedures (40 CFR 264.111).

I. obligates a contingency plan in the event of an emergency and must have an emergency coordinator at all times in the facility (40 CFR 264.55).

J. TSD must keep an "operating record" of the facility (CFR 264.75).

Major gaps in regulation of TSDs that have been identified under U.S. law include:

K. No requirement for an environmental impact study or analysis;

L. Cement kilns and utilities and other industries have been allowed to burn hazardous wastes under "interim" status for decades – although the 1991 Boiler and Industrial Furnace Regulations increased standards -- and cement kiln dust has not been regulated as hazardous waste, despite a 1995 study showing ash was hazardous and that aquifers had already been contaminated because of the improper disposition of incinerator ash.

M. underground injection of hazardous wastes of certain types of waste without pretreatment is allowed if the operator of an injection well can "prove" there will be no migration of the waste for 10,000 years.

N. Enforcement

EPA and authorized state officials have a broad range of enforcement options under RCRA, including:

O. Administrative actions, including both informal and formal actions;

P. Civil actions, and

Q. Criminal Actions.

In addition, provisions of RCRA allow individual citizens to initiate enforcement if the government fails to do so (7002 (a) of RCRA), leading to numerous cases of citizen groups initiating enforcement both against individual facilities as well as against governmental authorities for failure to enforce RCRA regulations.

Still, enforcement of RCRA and HTMA regulations at border crossings was weak during the early 1990s. There was little if any inspections of actual hazardous waste shipments by either state or federal environmental officials – due to lack of resources and jurisdictional issues -- and most U.S. Customs officials were improperly trained in hazardous waste shipping and reporting regulations. In addition, HAZTRAKS did not lead to enforcement cases, as expected, in the early 1990s.

B. Social Organization

R. Citizen's groups

Citizens have opposed both industries for improperly managing hazardous wastes as well as hazardous waste management facilities. Citizens used the state and federal permit processes to voice opposition in permit hearings, organize opposition and oppose permits through administrative hearings. Several have involved binational opposition to proposed hazardous waste landfills near the U.S. –Mexico border, including Texcor's proposed hazardous waste landfill near the town of Spofford in Kinney County and Chemical Waste Management's proposed hazardous waste landfill in Terrell County again near the Texas-Mexico, both of which were never constructed.

Both national environmental groups like the Sierra Club and Environmental Defense Fund, as well as local groups fighting individual cement plants have vociferously opposed the practice and the preferential treatment that cement kilns and other aggregate kilns have enjoyed under RCRA.

Citizens have also used lawsuits to sue the government. For example, the Environmental Defense Fund sued the agency in 1989 for failure to study whether cement kiln ash should be considered a hazardous waste, and therefore be managed as such, forcing the EPA to study the issue by January 1995. Furthermore, EDF sued the EPA for failure to promulgate Land Disposal Restriction (LDR) rules for newly-characterized wastes, as had been required by the 1984 amendments to RCRA.

S. Hazardous Waste Management Industry

Large petrochemical and chemical companies like Du Pont, Exxon, Shell and Dow Chemical manage most hazardous waste on-site. Among the companies with the most facilities and largest capacity to treat hazardous wastes off-site were Safety-Kleen, Burlington Environmental Services, U.S Ecology and USPCI. In terms of hazardous waste landfills and underground disposal wells, the leading industry was Chemical Waste Management, which today is known as Waste Management Inc. Commercial hazardous waste incineration was dominated by a few companies in the early 1990s, including Rhone-Poulenc, Rollins Environmental Services, Laidlaw Environmental Services, Chemical Waste and Aptus Inc.

Other combustion and energy recovery operations were dominated by the cement industry, taking advantage of looser regulations and acting in concert with waste management company which operated fuel blending facilities like Oldover, Systech Environmental Inc., Safety Kleen and Cadence Energy.

Table 1. Major Companies in the Commercial Hazardous Waste Industry, Number of RCRA-approved Facilities in 1994 in the U.S.

Table 2. Cement Companies which burned hazardous wastes in the U.S.., 1993

C. Disposal Capacity

A 1994 “National Capacity Assessment” required under CERCLA found that there was sufficient off-site commercial capacity in all major management categories in 2013 (U.S. EPA 1995: 13). According to the assessment, commercial facilities were spread throughout the U.S. with a significant concentration of commercial facilities in the Midwest (Ohio, Michigan, Mississippi, Illinois, New Jersey), Northeast (New York, Pennsylvania and New Jersey) and California and Texas.

Table 3. 1991 Management and Capacity of Hazardous Wastes in Commercial Systems and Expected Demand and Capacity in 2013

Table 4. 1994 Commercial Treatment and Disposal Facilities of RCRA Hazardous Waste by State and EPA Region

D. Domestic Waste Generation and Disposal

In the United States, the amount of hazardous waste generated by manufacturing industries increased from an estimated 4.5 million tons annually after World War II, to some 57 million tons by 1975, and 198 million tons in 1989 (Council on Environmental Quality: July 1981, 84) By 1991, a total of 23,423 Large Quantity Generators reported generating 305 million tons, largely because of a new EPA regulation called the Toxicity Characteristic (TC) Rule, which added 25 new hazardous waste codes (D018-D043) and required more stringent analytical tests for the presence of toxic constituents in waste. However, the EPA believes that total hazardous waste -- compared to production -- declined slightly between 1989 and 1993 as industries

enacted pollution prevention measures. More than 80% of these wastes were generated by a relatively few industrial facilities, most of which were chemical, petrochemical or petroleum refineries.

Table 5. Hazardous Waste Generation in the U.S., 1991 –1993

The vast majority of hazardous wastes in the U.S. are managed on-site. Almost 97% of all waste managed in 1991 were wastewaters, most of it at on-site treatment works. Waste managed off-site at either commercial or captive facilities was distributed among a host of management methods, including landfills, fuel blending facilities, stabilization and other treatment as well as metals recovery, incineration and energy recovery.

Table 6. Hazardous Waste Managed in the U.S., 1991-1993

Table 7. Tons of RCRA Hazardous Waste Managed Off-Site by Year and Management Method

Waste generated and managed has been distributed throughout the U.S., with significant concentrations in the states of Texas, Michigan, New York, California, New Jersey, Louisiana and Tennessee. The states bordering Mexico represented about a third of the waste generated and managed in 1991 and 1993, while the states bordering the Canadian border represented between 20 and 25%. Waste generated and managed on both the Canadian and Mexican borders appeared to be declining slightly in 1993 compared to 1991, especially in New York and Texas.

Table 8. Percentage of Hazardous Waste Managed and Generated by State and Region, 1991-1993

E. Transboundary Waste Movement

EPA kept poor records on imports and exports of hazardous wastes before NAFTA. For example, certain hazardous wastes which are exported for recycling such as lead batteries are exempt from reporting

requirements even though EPA knows significant amounts go to Mexico. In 1993, an analysis conducted by the EPA revealed that a total of 142,708.45 tons of hazardous wastes were exported to other countries, 99.5% of which was exported to either Canada or Mexico. Most of the waste exported was recycled or reclaimed (62.49%), or eventually went to landfills (27.74%). Between 1990 and 1993, the number of export notices and waste streams authorized stayed relatively stable (Table).

Table 9. Exports from the U.S. to Canada, Mexico and the Rest of the World, 1993

Table 10. Number of Waste Streams and Waste Notices of Exports, 1990-93

There is virtually no information available on imports of hazardous waste from before development of the Waste Imports Tracking System in 1995. According to HAZTRAKS, imports of RCRA hazardous waste from Mexico increased slightly between 1991 and 1993.

Table 11. Tons of RCRA hazardous waste and Number of RCRA Hazardous Waste Manifests received from Mexico, 1991-1993

Mexico

T. Government Policy

1. Introduction

In 1965, the Mexican government initiated the maquiladora program to increase foreign investment and generate employment and industry in Northern Mexico. Under the program, manufacturers do not have to pay import duties, and instead utilize an “in-bond” system, in which the manufacturer posts a bond, which is

returned when the final product is exported. The maquiladora program began to expand rapidly during the 1970s at a time when Mexico still did not have basic controls established on the management, generation and shipments of hazardous wastes.

In addition, government policy favored the protection of national industries and promotion of energy production and consumption, all of which led to industrial concentration and environmental consequences. Subsidized state industries such as CFE (Federal Energy Commission) and PEMEX (Mexican Petroleum) were among the largest and most-polluting industries in terms of hazardous wastes.

In the 1980s, the Mexican government drastically changed its policy, opening up its economy to investment and international prices, and ending protectionist measures and subsidies to national industries. The change also helped promote the maquiladora sector and the northern border began to receive a greater portion of investment and industrialization, as well as population increases.

In 1983, the Mexican government came to an agreement with the U.S. known as the La Paz Agreement. In 1986, the two countries adopted Annex III, which required the U.S. to take back hazardous wastes generated by the maquiladora industry from the imported raw materials.

In 1988, Mexico passed its still most important piece of environmental legislation, the General Law for Ecological Equilibrium and Environmental Protection (LGEEPA or General Law), which incorporated environmental issues, including management of hazardous wastes, into one regulatory scheme (see below).

2. Regulations and enforcement of hazardous waste at generation

The 1988 General Law imposed significant treatment and reporting requirements on hazardous waste generators. While the 1988 Law provided the regulatory framework for managing hazardous wastes, most of the actual federal environmental performance provisions and standards were not adopted until 1993 through

the NOMs, or Mexican Official Standards. In 1993, INE, through its National Consultative Committee for Environmental Standards, approved seven NOMs related to hazardous wastes and hazardous waste management.

In addition, in 1992, by presidential decree following a series of industrial accidents, the National Program for the Prevention of High-Risk Environmental Accidents went into operation, requiring risk assessments for many generators of hazardous wastes.

Finally, in 1993, Mexico passed the Regulations for Domestic Transport of Hazardous Wastes and Materials although implementation is still on-going.

Table 12: Requirements of Hazardous Waste Generators in Mexico, 1988-1993

Table 13. NOMs (Normas Oficiales Mexicanas or Official Mexican Standards) Related to Hazardous Waste Generation and Management

It is important to note that with these standards, Mexico adopted standards fairly similar to those of the U.S. although the definition of hazardous waste in Mexico and the way it is determined is different. In general, Mexico's definition is more expansive, meaning that many wastes that would be considered non-hazardous in the U.S. are considered hazardous in Mexico. Still, while much of the regulatory framework and performance standards were in place in Mexico by 1993, actual compliance with these standards was very low as both industries and the government struggled with implementation issues.

2. Hazardous waste tracking systems

Article 153 of the LGEEPA allowed the Mexican government to restrict the import and export of hazardous wastes and more specifically prevented hazardous wastes from being imported into Mexico for "final disposal or simple deposit, storage or landfilling in national territory," while allowing for the import of hazardous wastes for treatment, reuse or recycling. Article 55 mandated that hazardous waste generated from raw materials entering Mexico under the Maquiladora Program must be exported to the country of origin of the raw materials. With these two provisions, the 1988 LGEEPA provided Mexico's environmental framework for dealing with transboundary movements of hazardous wastes.

In order to implement the provisions contained in Articles 55 and 153, the LGEEPA requires a "Guia Ecologica" for each import and export of hazardous waste. In addition, waste producers must also complete a manifest for shipments of hazardous waste within Mexico.

Nonetheless, before NAFTA, Mexico had little information, at least available publicly on movement of hazardous wastes, either within Mexico or outside of its boundaries.

3. Regulation of the Hazardous Waste Management Industry.

The 1988 Law imposed regulations on facilities wishing to treat or dispose hazardous wastes. In addition, four NOMs were passed in 1993 which specifically set up standards for hazardous waste landfills. There are a variety of both performance and reporting requirements that Mexican TSD facilities must meet (Table). It is important to note that in 1993 Mexico had not passed specific performance standards for most TSD facilities, other than landfills, and officials had wide latitude through both the requirement that TSDs submit an Environmental Impact Assessment as well as through the operating permits themselves to impose operating standards.

Table 14. 1988 and 1993 Requirements under Mexican Law for Hazardous Waste Management Facilities

Mexico lacked specific regulations to require plans for total or partial facility closures, although such a plan may be required under the Environmental Impact Analysis. Mexican law also has no provisions for either financial assurance to adequately clean up the facility in the event of closure or provisions to obtain liability insurance.

4. Enforcement activities/indicators

According to information in 1994 there were more than 263,000 manufacturing and 180,000 service establishments in Mexico (PROFEPA 1998: Chapter II). The 1988 Environmental Law put many of these under federal jurisdiction, including all industrial and service companies which generate, transport, store, recycle, treat or dispose of such waste (PROFEPA 1998, Chapter II). Since 1992, the principle federal enforcement agency for environmental laws has been the Federal Attorney for Environmental Protection (hereafter PROFEPA).

In 1992, the new agency began to increase inspections of major industries to attempt to increase compliance with environmental laws. These were divided into “rapid” visits designed to create a census, and more comprehensive inspections. During these visits, Mexican authorities found significant problems complying with environmental laws. However, over a relatively short period, the number of industries with major violations of environmental laws decreased significantly, even as the number with “slight” or minor violations increased.

Table 15. Number of regular and quick inspections of manufacturing facilities by PROFEPA in Mexico, 1992 –1994

Table 16. Rates of compliance with all environmental regulations, August 1992 – December 1994

Mexico's authorities had a number of enforcement options available in the event of non-compliance with environmental regulations, including closures, partial closures and penalties. In addition, in 1992, Mexico began a "compliance assistance" program called the National Environmental Auditing Program, a voluntary process to bring industry into compliance. Authorized under Article 38 bis of the General Law, the Auditing Program uses an established methodology to audit the company's environmental performance, including a compliance assessment, preventative and corrective measures, and an action plan to meet these measures. In return, these facilities largely escaped fines and penalties for violations of environmental regulation.

Table 17. Number of Environmental Audits Conducted and Action Plan Agreements, 1992-1994

B. Social organization

U. Citizen's groups

Citizens in Mexico did not enjoy the same access to environmental information or to the courts as did citizens in the U.S. and Canada, making it more difficult to influence governmental environmental policy or, for that matter, the hazardous waste management industry.

Still, significant social movements began to emerge in the early 1990s in Mexico, some of which focused on poor environmental performance by maquiladoras and abandoned hazardous waste sites. Of particular interest is that Mexican officials and citizens also became involved in cross-border citizen campaigns against the location of hazardous waste landfills in the border with Mexico. In 1993 and 1994, in part because of the efforts of Mexican citizens, two hazardous waste landfills in Texas were not granted final permits (see U.S. section for more detail).

There are two main mechanisms for the public to become involved in enforcement of environmental laws. First of all, under the LGEEPA, any citizen may file a popular complaint, or *denuncia popular*, with PROFEPA for anything within federal jurisdiction that harms the environment. PROFEPA then has 30

working days to inform the complainant of any results of its investigation and any measures being taken. If the citizen does not agree with the results or measures, they may file a request to reconsider or amend the resolution, or bring a suit, known as an amparo, before a District Judge.

Citizens filed more than 8,000 complaints with PROFEPA State Offices and nearly 4,000 complaints with central offices between 1992 and 1994 (PROFEPA 1998: Chapter IV). About 25 % of the complaints filed with state offices were along the U.S. –Mexico border (PROFEPA 1998, Chapter IV).

Table 18. Petitions Received by State Offices of PROFEPA, 1992-1994

An amparo demand or suit is a legal action which seeks to annul, repair or suspend any governmental action which violates an individual's guaranteed rights. The complainant party must, however, show that the harm is "personal and direct" and show a legitimate or legal interest in the harm being sought to be repaired. These two provisions make it extremely difficult for citizens to pursue a legal action against governmental action or inaction since they must demonstrate both the environmental harm and a personal and direct causation with that harm. In addition, the amparo process only applies to the aggrieved party filing the suit and can not be used as part of a class action suit. In addition, the Environmental Auditing program begun in 1992 involves an agreement between industry and governmental authorities, keeping information confidential and out of the public sphere.

2. The Hazardous Waste Management Industry

In the early 1990s, most hazardous waste management was either handled on-site by generating industries or treated, burned, recycled or burned at one of the 79 facilities then authorized by the Mexican government. One area that began to expand in the early 1990s was the burning of hazardous wastes in cement kilns. In 1993, Mobley Environmental Services, a Texas company specialized in liquid hazardous waste management, joined forces with CEMEX – Cementos Mexicanos – one of the largest cement companies in the world, to

form Pro Ambiente, S.A. de C.V. That same year, Pro Ambiente build a facility at CEMEX's plant in Torreon, Mexico to blend "alternative" fuels such as used oils and lubricants for incineration at CEMEX plant. (CEMEX later bought Pro Ambiente outright). The cement plant began burning such fuels in 1994 using a temporary authorization from INE.

Similarly, Cementos Apasco, partially owned by Swiss Cement-giant Holderbank, signed a joint investment agreement in 1993 with Chemical Waste de Mexico to open a fuel blending plant called Ecoltec near the cement plant in Ramos Arizpe, Coahuila. The plant would be partially fueled by hazardous wastes – mainly solvents -- both from the Ecoltec plant as well as by a transfer station owned by Chem Waste in El Salto, Guadalajara. Apasco also began burning tires at some facilities in 1993.

Metalclad, a California company, also began investing in Mexico in 1991, setting up several subsidiaries, including Ecosistemas Nacionales, which ran a fuel blending facility in Tenango, Morelos called Química Omega, which provided alternative fuels to two CEMEX cement plants in the state of Hidalgo. Later, in 1994, Brown Ferris Industries invested in the plant, changing the name to BFI Omega. Metalclad also began actively searching for sites to open a hazardous waste landfill in Mexico, finally locating a site in 1993 in the state of San Luis Potosí.

Thus, by 1994, several U.S. companies, including Chem Waste Management, Metalclad, Mobley Environmental Services and BFI had invested in the Mexican hazardous waste management industry. However, total investment in Mexico in the industry was relatively small, with INE estimating that $115 million had been invested by national and foreign companies (INE/SEMARNAP 1996, Chapter III).

C. Disposal capacity

Mexican officials estimated that in 1994, only 12 percent of the waste generated in Mexico was being adequately treated and disposed of in Mexico (INE 1996, Chapter III). Most of this disposal capacity was the result of a single landfill – RIMSA. In all, INE estimated a total of 79 facilities or companies that treated, disposed or recycled hazardous waste, as well as 71 facilities which collected or transported hazardous wastes. However, INE could not provide any data on either the total amount of waste managed at these facilities or the total capacity, other than that it was not nearly sufficient to treat all the hazardous wastes generated in the country.

Table 19. Number of Facilities Authorized to Transport, Collect or Manage Hazardous Wastes in Mexico, 1994

D. Domestic Waste generation and disposal.

Little information about the amount of hazardous waste generated and disposed of in Mexico existed prior to 1995. However, a 1996 study released by INE estimated that in 1994, manufacturing industries in Mexico produced 8 million tons of hazardous wastes (INE 1996, Chapter II). About 20% of this waste was estimated to be concentrated in the northern border states, while the majority – about 60% -- was believed to be generated in the center of the country near Mexico City.

Table 20. Estimated Generation of Hazardous Wastes in the Mexican Border States, 1994

The sources of hazardous waste in Mexico included:

*Those generated by Mexican national companies, like petro-chemical and chemical plants (40%), metal and metal-making industries (20%) and electronic industries (8%) (INE 1996: Figure 1.8);
*by the maquiladora industry located within Mexico as well as other companies importing raw materials temporarily into Mexico; and

*hazardous waste imported into Mexico for recycling or recuperation of hazardous materials.

The same 1996 document reported that a large amount of the waste was believed to be deposited illegally, either on-site, in municipal landfills or in clandestine dumps. Most hazardous waste that was managed properly was being sent to RIMSA –the hazardous waste landfill located near Monterrey, Mexico. PROFEPA reports that their own figures suggest that 70,000 tons of waste was sent to landfills in 1992, a total that increased to 193,000 tons by 1994 (PROFEPA 1998, Chapter II-5).

PROFEPA has detailed many of the environmental impacts resulting from mismanagement of hazardous wastes in its reports, as have Mexican non-governmental organizations and neighborhood groups. One of the most serious concerns has been the existence of illegal disposal sites. One of the best known is the case of Alco Pacífico, a U.S. company that recycled used car batteries. The company was shut down in 1991 by PROFEPA due to mismanagement of hazardous wastes. Nonetheless, about 23,000 tons of hazardous waste was left behind and remained at the site until the late-1990s (PROFEPA 1998, Chapter IV).

Industrial accidents were also common before NAFTA. Nonetheless, before 1993, Mexico did not keep comprehensive records of industrial accidents (PROFEPA 1998, Chapter III).

E. Transboundary movement

Unfortunately, little data exists from Mexico about the transboundary movement of hazardous wastes before 1995. Citing its own figures – not those generated from a tracking system -- PROFEPA reports that maquiladoras exported about 3,000 tons of hazardous wastes in 1992, an amount that increased to 27,500 by 1994 (PROFEPA 1998, Chapter II-6). At the same time, PROFEPA estimates that approximately 150,000 tons of waste were being imported into the country. The figures suggest that few maquiladoras were complying with repatriation requirements, or at least not reporting them to Mexican authorities before 1994.

A. Government Policy

CANADA

1.Introduction

Canada is party to two major international agreements related to the transboundary movement of hazardous wastes; the *1986 Canada-US Agreement on the Transboundary Movement of Hazardous Wastes* and the *Basel Convention on the Transboundary Movement of Hazardous Wastes*, which Canada ratified in 1992.

Provincial governments have taken primary responsibility for regulating the handling and disposal of hazardous wastes. The role of Canada's federal government has been limited to regulating the international and interprovincial movement of wastes, and the handling and disposal of specific substances, such as PCB's which are declared to be "toxic" substances for the purposes of the *Canadian Environmental Protection Act* (CEPA, S. 11).

V. Regulations and enforcement of hazardous waste at generation

Federal

Canada has no federal regulatory controls on hazardous waste generation, or requirements that waste generators receive approvals under federal legislation before commencing operations. Nor have any reporting requirements been established for hazardous waste generators at the federal level.

Some waste generation is reported through the National Pollutant Release Inventory (NPRI), established in 1992 under the *Canadian Environmental Protection Act (CEPA)*. The NPRI initially required

facilities to report their on-site releases (to air, water, land, and underground injection) and off-site transfers to treatment and disposal of 178 specific substances to the federal environment department (Environment Canada) annually. The manufacturing, processing or otherwise using of 10 tons or more of a substance in a given year triggered reporting. The first year for which pollutant release and transfer data was reported under the NPRI was 1993, and Environment Canada releases the reported date to the public each year.

With the exception of PCB storage facilities (Storage of PCB Materials Regulations SOR/92-508) there are no federal requirements regarding the development of emergency response plans for hazardous waste treatment and disposal facilities currently in place in Canada.

Provincial

Hazardous waste generators are generally not subject to regulation or approval requirements by provincial environment departments or ministries under provincial environmental protection legislation unless the are storing quantities of waste on-site for an extended period of time. However, activities which result in releases of wastes or contaminants to the environment, or the operation of on-site disposal facilities (e.g. incinerators or landfills) are typically subject to approval requirements under provincial legislation. Provincial agencies typically have wide discretion in the imposition of terms and conditions on such approvals (Swaigen. 1993, chapters 16-19).

Most provinces established hazardous waste generator registration requirements linked to hazardous waste movement manifesting in the 1980s. However, this is usually a one-time only requirement, and there are no regular reporting requirements for waste generators.

There are no general requirements for emergency response plans by hazardous waste generators under provincial legislation. Fire safety plans may be required for facilities which use or store flammable materials in some provinces under fire safety legislation. In addition, conditions related to emergency

prevention and response may be included in the approvals granted to waste generators or waste management facilities under provincial environmental legislation. However, the application of such requirements varies from province to province, and even from facility to facility (Winfield May 2000).

3.Hazardous waste tracking systems

Federal

The federal government's principle role with respect to the management of hazardous waste is centred upon their interprovincial and international movement. The *Export and Import of Hazardous Wastes Regulations*, made under CEPA in 1992, require that approval be obtained from Environment Canada before a waste import or export can take place. In practice Environment Canada has relied upon the judgement of the jurisdiction (country in the case of exports or province or territory in the case of imports) as to the acceptability of the waste movement, and granted approvals on that basis.

Under the regulations, a waste manifest describing the waste accompany the shipment at all times, the exporter/importer must carry insurance to cover any damages to third parties for which the exporter or importer is responsible, and to cover environmental damage due to spills leaks or other incidents during export or import. Canadian exporters must also accept the return of wastes that are refused by the importer. Primary responsibility for the enforcement of the regulations at the border lies with Canada Customs.

Regulations banning the export of PCB wastes to any destination other than the United States were adopted in 1990.

Provincial systems.

During the 1980's all Canadian provinces have implemented hazardous waste shipment manifesting systems to track movements of hazardous wastes under their environmental protection legislation. These typically establish requirements that manifests accompany waste movements at all times, and provide for monitoring and tracking systems to ensure that wastes are only accepted by facilities approved to receive them under provincial legislation. In some provinces the waste manifest data is made available to the public on an annual basis.

The provincial manifesting systems are generally designed to link with the federal requirements under the CEPA transboundary waste movement regulations in the case of international waste movements in and out of the province.

3.Regulation of the Hazardous Waste Management Industry.

Federal

No federal approvals are required to operate hazardous waste disposal sites or systems in Canada. Federal regulations for controlling hazardous waste disposal only exist for federally owned PCBs (Federal Mobile PCB Treatment and Destruction Regulations, 1989 SOR 90-5). Hazardous waste management facilities are required to report substance releases and transfers above NPRI reporting thresholds through the NPRI program.

Provincial

During the 1970's and 1980's all provinces established requirements for approvals under their environmental protection legislation for the construction and operation of hazardous waste disposal sites or

systems. These included transportation and transfer services. In some provinces such systems were subject to mandatory public hearings before they could be approved.

In addition, in some provinces environmental assessments were required for proposed facilities, although the application of these requirements, and the contents, varied widely from province to province, and even within a given province. Environmental assessments could include an examination of wider issues related to such things as the need for facilities, and the availability of alternative waste disposal technologies, than are considered in the approval process under environmental protection statutes (Swaigen 1993, Chapter 9).

Specific requirements related to the construction and operation of disposal sites, and waste handling and disposal practices were established on a case-by-case basis as terms and conditions of the approvals granted to individual facilities. As outlined in Figure 1, no universally applicable standards for facility operations or waste disposal, comparable to those established for hazardous waste disposal facilities under the US *Resource Conservation and Recovery Act* were established.

4.Enforcement activities/indicators

Federal

The federal government's enforcement activities related to the CEPA hazardous waste regulations are reported through annual reports on the administration and enforcement of the Act tabled each year in Parliament. However, as the regulations only came into force in late 1992, enforcement data only exists for 1994 onwards.

Provincial

Environment 1995). The enforcement of regulations related to hazardous handling and disposal were consistently identified as priority targets for environmental law enforcement efforts in Ontario and Quebec in the late 1980s and early 1990s.

B. Social organization

1.Citizen's groups

Potential host communities had traditionally opposed the establishment of new hazardous waste disposal capacity, particularly facilities that might receive out of province wastes. In fact, it became an increasingly accepted view in the late 1980's and early 1990s it was impossible to site disposal facilities in the face of determined local opposition (Rabe 1994). This seemed particularly true in the context of the environmental assessment requirements for proposed facilities applicable in most provinces, and the availability of intervenor funding to *bona fide* public interest intervenors in such processes in key provinces, particularly Ontario.[14]

2. The Hazardous Waste Management Industry

The hazardous waste disposal industry's ability to influence public policy in this area was historically strong, but not overwhelming. The poor record of performance of private sector disposal facilities in the 1970's, lead a number of provinces, including Ontario, Alberta, and Manitoba to establish Crown corporations for the purpose of constructing publicly owned and operated treatment and disposal infrastructure (Winfield 1992).

[14] See the Ontario *Intervenor Funding Project Act, 1989.*.

At the same time, government policy at federal and provincial levels, as evidenced by the 1986 Canada-US Agreement on the Transboundary Movement of Hazardous waste, favored open borders to hazardous waste traffic. The rationale for this policy was to permit disposal at nearest available facility, regardless of which side of the border it was on, thereby reducing the risks of spills or accidents during transport (Winfield 1992).

C. Disposal capacity

Specialized commercial hazardous waste disposal facilities first began to be established in Canada in the late 1960's. This capacity was limited to Ontario and Quebec, with major facilities including incinerator/landfill complexes operated by Laidlaw ltd. near Sarnia, Ontario and Mercier, Quebec, both of which received imported as well as domestically generated wastes.

During the 1970's the disposal of waste in municipal waste landfills was generally phased-out, and some older incineration facilities shut down. A commercial stabilization operated by Stablex Ltd. was established in Blainville, Quebec in 1983 (Stablex Canada 2000). This facility also received imported and domestic wastes.

Concerns over the lack of disposal capacity, degree to which existing disposal capacity was controlled by one operator (Laidlaw Ltd) and lack of public confidence in private disposal facility operators lead the province of Ontario to establish a Crown Corporation, the Ontario Waste Management Corporation, (OWMC) for the purpose of constructing a comprehensive treatment and disposal facility in 1980. However, this facility was never constructed (Jackson 1983).

The only other r

from receiving out of province wastes as one of the conditions related to willingness of the host community

to accept the facility (Winfield 1992, Chapter VI). A smaller and less comprehensive physical/chemical treatment facility was also established by the Manitoba government in 1993.[15]

D. Domestic Waste generation and disposal.

Very limited reliable data on hazardous waste generation and disposal in Canada is available prior to the mid-1980's, when generator registration and comprehensive hazardous waste manifesting systems were introduced at the provincial level. Even these systems were limited in terms of the data which they generated on on-site disposal, as generator registration was only required on a one-time only rather than annual or biennial basis. The Canadian Hazardous Waste Inventory, completed by Environment Canada in 1995 on the basis of 1991 data, estimated total waste hazardous generation in Ontario to be in the region of 1.5 million tons per year. Estimates for total waste generation in Ontario developed by the Ontario Waste Management Corporation are the only historical data available on hazardous waste generation in Canada (Winfield May 2000, Table IV-2).

Table 21 : Total Hazardous and Liquid Industrial Waste Generation in Ontario 1986-1991

Table 22: Ontario Manifested Hazardous and Liquid Industrial Waste Quantities

In general, the available data indicates that from the mid 1980s to the early 1990's generation rates followed the overall economic performance closely, growing as the economy expanded, and falling during periods of recession

[15] Operated by the Manitoba Hazardous Waste Management Corporation in Montcalm, Manitoba. The corporation's business was taken over by the Toronto based Miller Environmental Corporation in

E. Transboundary movement

Virtually no reliable data exists on transboundary movements of hazardous wastes in and out of Canada prior to the establishment of comprehensive waste manifesting systems at the provincial level in the mid-1980s. The federal regulations made under CEPA regarding transboundary hazardous waste movements did not come into force until 1992.

Data from Environment Canada from 1987 to 1992 presented in Table 23 shows that waste imports remained roughly stable during this period, while exports showed a significant growth.

Table 23: Total Waste Imports and Exports to and From Canada 1987-1998

Data from 1987 to 1991 shows a steady rise in exports, before leveling off from 1992 onwards. While imports remained relatively stable until the 1993, when they began to show a dramatic rise. Transboundary traffic was almost entirely between the provinces of Ontario and Quebec, and the United States.

1996.

APPENDIX B: Tables from Main Report and Appendix A.

TABLES FROM MAIN TEXT

Table 1. Major New Rules Adopted by U.S. EPA under RCRA and CAA, 1994-2000

Name of Rule	Date	Description	Impact on waste
Phase III Land Disposal Restrictions Carbamate Wastes	April 8, 1996 November 1, 1996 Court of Appeals vacated several standards September 4, 1998 Final Rule	Required concentration-based treatment standards for waste associated with production of some carbamate pesticides; However, court case threw out treatment standards for eight of constituents; Final rule includes treatment standards for seven constituents.	Pesticide generators given choice of specified treatment methods or meeting concentration levels. Ultimately impacted few generators.
Phase III Land Disposal Restrictions Aluminum Spent Potliners	April 1996 September 1998 Final Rule	Required new concentration-based and treatment standards for aluminum spent potliners; However, litigation caused delay and changes in final rule.	Will require a small percentage of aluminum spent potliner waste containing arsenic to be treated through vitrification; other aluminum spent potliner waste must be treated through combustion or stabilization.
Phase IV Land Disposal Restrictions Wood Preserving Wastes	May 12, 1997	Established treatment-based standards for wood preserving wastes, requiring combustion for organics, including dioxins and furans; stabilization for chromium standards; and vitrification for arsenic constitutuents.	Expected to shift some waste managed on-site to off-site facilities, including incinerators, cement kilns, landfills and a vitrification facility in Arkansas (Reynolds Metals Company).
Phase IV Land Disposal Restrictions Toxicity Characteristic Metal	May 26, 1998	(1)Requires metal wastes characterized hazardous by the TCLP but not the	Expected to shift some waste off-site to incinerators, cement kilns,

Wastes		Extraction Procedure to undergo stabilization or metal recovery before landfilling; (2) Requires underlying hazardous constituents in metal wastes to be treated, as well as establishing stricter treatment standards for 12 metal constituents.	stabilization and commercial landfills following treatment.
Phase IV Land Disposal Restrictions Mineral Processing Wastes	May 26, 1998	Wastes excluded from treatment under Bevill Amendment forced to treat wastes prior to land disposal.	Expected to cause 71,000 tons of mineral waste to require stabilization treatment.
Newly Listed Wastes Petroleum Refining Wastes	August 8, 1998 Wastes Listed February 9, 1999 Went Into Effect	Required concentration-based treatment standards for four petroleum refining wastes	Expected to shift onsite wastes to off-site commercial facilities, most of which will be stabilized, incinerated or fuel blended for combustion.
Newly Listed Wastes- Organobromine Waste	1997 – currently in litigation.	Required treatment standards for organobromine.	Only affects Great Lakes Chemical Corporation.
Emission Limits for Hazardous Waste Combustion Facilities	April 19,1996- Rules Proposed September 30, 1999 – Rules Finalized Facilities have 3 years to meet standards.	Establishes more stringent Maximum Achievable Control Technology (MACT) emission standards for hazardous waste incinerators, waste burning cement kilns and lightweight aggregate kilns for dioxins, furans, mercury, lead, cadmium, antimony, arsenic, beryllium, chromium, particulate matter and chlorine gas.	EPA estimates at least 90% of facilities will have to make substantial investments to meet standards. Likely result will be less on-site burning of hazardous wastes in incinerators and kilns, with larger commercial incinerators and cement kilns burning wastes.
Hazardous Waste Identification Rule – Contaminated Media	Proposed rule published December 21, 1995 Final rule	Exempts from hazardous waste regulations, including treatment standards, some waste at low	Will reduce off-site management of some hazardous wastes from Superfund sites and other RCRA

	published November 2, 1998 Final rule not expected until April 30, 2001	constituent concentrations. Only applies to cleanup activities, not process waste.	clean-up.
Hazardous Waste Identification Rule – Process Waste	Proposed rule published December 21, 1995 Final rule not expected until April 30, 2001	Would exempt from hazardous waste regulations and treatment standards certain process waste at low concentrations of toxicity.	Impact will depend upon concentration levels specified in final rule.

Source: TNRCC March 2000: 14-23.

Table 2. RCRA Treatment, Storage and Disposal Facilities: % Inspected, % in Significant Non-Compliance and Number of Formal Enforcement Actions, Mexican Border States, Canadian Border States and Nation, FY 1995-1999

Region	1995	1996	1997	1998	1999
% TSDs Inspected					
Texas	61%	34%	33%	48%	50%
California	53%	29%	24%	33%	34%
US/Mexico Border States	59%	34%	29%	42%	44%
US/Canadian Border States	69%	34%	33%	68%	74%
Total Nation	65%	21%	33%	59%	63%
% TSDs in SNC					
Texas	18%	10%	9%	16%	15%
California	7%	2%	1%	1%	0%
US/Mexico Border States	15%	7%	5%	10%	8%
US/Canadian Border States	13%	5%	6%	16%	14%
Total Nation	4%	7%	6%	14%	13%
# Formal Enforcement Actions					
Texas	45	12	29	21	16
California	8	7	0	2	1
US/Mexico Border States	61	30	30	28	17
US/Canadian Border States	57	38	49	32	25
Total Nation	305	229	205	172	180

Note: US-Mexico Border States include Arizona, California, New Mexico and Texas;
US-Canadian Border States include Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, North Dakota, Ohio, Pennsylvania, Vermont and Washington.

Source: FY95 –FY97: US EPA, State-by-State Enforcement Data Summaries, FY95-FY97 and FY 1998 and FY1999 Program Status Reports

Table 3. Estimated Hazardous Waste Source Reductions from Large Quantity Generators in Texas, 1995-1998

Year	Amount Source-Reduced, Millions of Tons
1995	4.8 million
1996	4.8 million
1997	1.7 million
1998	1.2 million

Source: Information provided by Susan Rootham, TNRCC

Table 4. RCRA Treatment Storage and Disposal Facilities: % Inspected and % in Significant Non-Compliance within 100 kilometers of U.S –Mexico Border, FY 99

State	# Facilities	# Facilities Inspected	% Facilities Inspected	# Facilities in Significant Non-Compliance	% Facilities in Non-Compliance
Arizona	8	6	75%	1	13%
California	16	7	44%	0	0%
New Mexico	4	4	100%	0	0%
Texas	34	18	53%	7	21%
Total 100 Kilometer Zone	62	35	56%	8	13%
National	3096	1961	63%	354	11%

Source: Information provided by Office of Enforcement and Compliance Assistance, U.S. EPA.

Table 5. Total Trucks Entering U.S. at U.S. Points of Entry on U.S.-Mexico Border, 1991-99

	1993	1994	1995	1996	1997	1998
PORTS						
TEXAS						
Brownsville	224,147	264,345	233,615	224,537	238,175	273,087
Del Rio	32,672	32,719	36,601	39,107	43,530	50,949
Eagle Pass	45,318	55,046	54,779	54,269	68,385	85,974
El Paso	563,413	580,200	610,177	539,650	596,538	591,258
Fabens	3,199	700	269	141	178	181
Hidalgo/Pharr	147,492	158,405	174,049	198,260	225,337	261,322
Laredo	473,480	659,924	733,783	899,754	1,162,419	1,340,65
Presidio	5,606	4,764	5,291	2,987	3,823	6,683
Progreso	23,760	22,711	22,962	21,978	17,963	17,298
Rio Grande City	15,649	15,655	14,936	11,937	16,867	18,658
Roma	14,110	12,273	11,426	12,630	12,019	13,140
Texas Total	1,548,846	1,806,742	1,897,888	2,005,250	2,385,234	2,659,20
NEW MEXICO						
Colombus	1,345	1,351	2,087	2,426	1,997	4,004
Santa Teresa	n/a	4,554	5,360	13,611	31,788	31,093

New Mexico Total	1,345	5,905	7,447	16,037	33,785	35,097
ARIZONA						
Douglas	18,300	47,522	38,242	34,585	41,802	35,561
Lukeville	2,278	2,419	2,665	2,766	3,254	3,723
Naco	4,521	5,043	5,789	5,610	6,578	7,650
Nogales	185,107	187,423	203,298	225,274	236,425	256,494
San Luis	36,620	43,356	44,214	44,377	45,175	42,472
Sasabe	1,691	1,308	1,180	1,512	1,393	1,844
Arizona Total	248,517	287,071	295,388	314,124	334,627	347,744
CALIFORNIA						
Andrade	1,420	3,114	3,818	3,935	3,078	2,137
Calexico	156,381	176,825	176,420	169,403	190,160	222,105
Otay Mesa	384,615	428,086	477,390	475,427	558,383	599,001
San Isidro	0	0	0	0	0	0
Tecate	36,710	34,674	41,064	45,932	64,262	57,914
California Total	579,126	642,699	698,692	694,697	815,883	881,157
GRAND TOTAL	2,377,834	2,742,417	2,899,415	3,030,108	3,569,529	3,923,201

Source: Data Provided by U.S. Customs Service, 2000.

Table 6. Estimated Number of Port of Entry Investigations, Border Investigators, Warehouse Investigations, Transporter/Transfer Facility Investigations, and Notice of Violations Issued in Border States, FY 98 – 00

	El Paso Office, Texas	Harlingen Regional Office, Texas	Laredo Regional Office, Texas	San Diego County, California***	Imperial County, California	New Mexico (2 ports)	Arizona (6 Ports)
Number of POE Inspections*, FY 99	67	45	0	52 (Weekly) 2000-3000 trucks inspected	52 (Weekly) 2000-3000 trucks inspected	1/month	Ports visited at leas once/month
Number of POE Inspections, FY 00**	26	36	0	52 (est.) 2000-3000 trucks inspected	52 (est.) 2000-3000 trucks inspected	1/month	Ports visited at leas once/month
Number of RCRA Investigators employed in area with emphasis on border crossings	2	3	0.5	1	1	0****	0****
NOVs Issued for POEs	0	0	0	NA	NA	0	

Warehouse Investigations, FY 99	21	7	0	NA	NA		
Warehouse Investigations, FY 00**	13	13	0	NA	NA		
NOVs for Warehouse Investigations, FY 99-00**	2	2	0	NA	NA		
Investigations of transporter/transfer facilities, FY 99	3	70	11	NA	NA		33 inspections of facilities, including warehouses and transfer facilities, NOVs issued

*Inspection is defined as a full day at the bridge, or 10 hours.
**Through July 31, 00
***California's Department of Toxic Substances Control contracts with the Department of Environmental Health, County of San Diego to monitor import and export of hazardous wastes and assist with other border activities. In Fiscal Years 99/00, DTSC provided the County of San Diego $143,515.00 to hire one inspector, as well as support staff and materials.
**** Once a month, the State of New Mexico sends inspectors from Santa Fe to the two POEs in New Mexico to conduct a "Border Check," in which U.S. Custom Inspectors are interviewed. At least once a month, two inspectors from the Arizona Department of Environmental Quality visit the six POEs in Arizona at least once a month.

Source: TNRCC August

Table 7. Major Commercial Hazardous Waste Combustion and Disposal Facilities Operating in the U.S., 1999

Treatment Technique	Company	Number of Facilities
Landfills	Safety Kleen	6
	Waste Management	5
Total Landfills in U.S.		21
Incinerators	Safety Kleen	6
Total		20
Deep Well Injection Facilities	Waste Management	2
Total		11
Cement Kilns Burning Hazardous Wastes		18

Sources: EPA 1999; Waste Management 2000; Safety Kleen 2000.

Table 8. Hazardous Waste Generators and Generators in the U.S., 1993 – 97

	1993	1995	1997
LQGs	24,350	20,853	20,305
Tons of Hazardous Waste	258,449,001	214,092,505	40,676,075
Tons of Hazardous Waste Generated by Top 50 LQGs	211,772,570 (82%)	178,269,725 (83%)	32,105,395 (79%)
Approximate Tons of Hazardous Waste Generated, not including wastewater, except for deep-well injection (1)	64,500,000	43,600,000	40,680,000

Notes: (1) To calculate this row, the following management categories were eliminated from the 1993 and 1995 on-site and off-site management totals: Aqueous Inorganic Treatment, Aqueuos Organic Treatment, Aqueous Inorganic and Organic Treatment and Other Treatment. The EPA reported in its 1997 Biennial Report that hazardous waste actually increased from 36.3 million to 40.6 million between 1995 and 1997. Whatever the methodology, total waste generated differed little between 1995 and 1997.

Source: U.S. EPA, National Biennial RCRA Hazardous Waste Report (Based upon 1993, 1995 and 1997 Data).

Table 9. Hazardous Waste Managed in the U.S., 1993-1997

Category	1993	1995	1997
Number of TSDs	2,584	1,983	2,025
Number of Non-Storage TSDs	1,032	900	626
Number of Off-site TSDs	432	732	310
Tons of Hazardous Waste Managed	234,864,033	208,267,945	37,723,129
Tons of Non-Wastewater Managed	14,946,832	10,214,536	11,540,819
Tons of Hazardous Waste Managed Off-site	8,309,165	8,722,387	6,810,921
Tons of Hazardous Waste Managed Off-site, not including wastewater, except for deepwell injection	6,604,769	7,021,385	6,810,921

Source: U.S. EPA, National Biennial RCRA Hazardous Waste Report (Based upon 1993, 1995 and 1997 Data).

Table 10. Tons of RCRA Hazardous Waste Managed Off-site by Year and Management Method

Off-Site	1993	1995	1997	
	Tons Managed	Tons Managed	Tons Managed	Percentage
Management Method				
Metals Recovery (For Reuse)	440,894	397,861	819,868	22.6
Solvents Recovery	430,519	291,180	530,703	19
Other Recovery	118,600	68,499	102,446	9.7
Incineration	487,576	645,471	531,693	26.5
Energy Recovery (Reuse as fuel)	920,579	1,005,767	901,439	15.8
Fuel Blending	956,303	2,254,669	1,324,814	29
Aqueous Inorganic Treatment	577,667	587,800	No data	No data
Aqueous Organic Treatment	178,809	207,757	No data	No data
Aqueous Org & Inorg Treatment	44,527	107,334	No data	No data
Sludge Treatment	4,606	2,808	20,025	3.5
Stabilization	707,883	804,011	1,119,623	15.2
Other Treatment	903,393	798,111	No data	No data
Land Treatment/Farming	57,546	353	0	0.6
Landfill	1,732,070	812,237	946,673	13.9
Surface Impoundment	No data	No data	No data	No data
Deepwell/Underground Injection	701,719	622,887	488,340	5.5
Other Disposal	44,605	15,641	25,295	8.1
Unknown System Due to Invalid Code	1,869	No data	No data	No data
Total	8,309,165	8,722,387	6,810,921	100
Totals Common to All Four Years	6,604,769	7,021,385	6,810,921	

Source: U.S. EPA, National Biennial RCRA Hazardous Waste Report, 1993-97

Table 11. Percentage of Hazardous Waste Managed and Generated by State and Region, 1993-1997

State or Region	% Generated, 93	% Generated, 95	% Generated 97	% Managed, 93	% Managed, 95	% Managed, 97
Texas	24.6%	32%	46.6%	22.4%	36%	46%
California	5.4%	5.2%	1.7%	5.4%	6.5%	3.1%
All Mexico Border States (1)	30.2%	37.3%	48.6%	27.9%	42.6%	49.6%
Michigan	8.1%	6.3%	2.4%	8.8%	6.9%	2.9%
Washington	5.6%	1.4%	0.3%	4.3%	0.8%	0.1%
New York	0.6%	1.1%	1%	0.5%	0.2%	1.1%
Ohio	0.7%	0.9%	4.2%	0.7%	0.8%	4.6%
Pennsylvania	3.7%	3.0%	0.9%	3.9%	3.0%	1.3%
All Canada Border States	21.9%	13.6%	12.8%	21.5%	12.6%	13.4%

(2)						
Louisiana	12.3%	8.2%	11.4%	13.4%	8.5%	11.9%
New Jersey	7%	4.8%	0.9%	7.5%	5.3%	0.2%
Tennessee	13.1%	18.1%	1.8%	14.5%	18.6%	1.1%

A. Includes Arizona, California, New Mexico and Texas;
B. Includes Idaho, New Hampshire, Maine, Michigan, Minnesota, Montana, New York, New Hampshire, North Dakota, Ohio, Pennsylvania, Vermont and Washington.

Source: U.S. EPA, The National Biennial RCRA Hazardous Waste Report (Based on 1993, 1995 and 1997 Data), April 1994, August 1995

Table 12. Quantity of Hazardous Wastes Received Off-Site in Selected States, 1995-1997

State	1995	% 1995	1997	%1997
Texas	828, 577	10.5	512,619	6.4
California	319,188	4.0	1,535,991	19.2
All Mexico Border States (1)	1,163,098	14.7	2,058,088	25.7
Michigan	1,076,175	13.6	732,643	9.2
Washington	12,520	0.2	36,760	0.5
New York	191,829	2.4	261,477	3.3
Ohio	577,617	7.3	693,041	8.7
Pennsylvania	431,013	5.4	446,935	5.6
All Canada Border States (2)	2,425,351	30.7	2,411,359	30.3
New Jersey	1,090,521	13.8	46,148	0.6
Indiana	502,050	6.3	611,458	7.6

A. Includes Arizona, California, New Mexico and Texas;
B. Includes Idaho, Maine, Michigan, Minnesota, Montana, New York, New Hampshire, North Dakota, Ohio, Pennsylvania, Vermont and Washington.

Source: U.S. EPA, The National Biennial RCRA Hazardous Waste Report (Based on 1997 Data), Exhibit B.4 and 3.11.

Table 13. Exports from the U.S. to Canada, Mexico and the Rest of the World, 1993-1995

Country of Import	Management Method	Quantity in Tons, 93	Quantity in Tons, 94	Quantity in Tons, 95
CANADA	Reclaimed/Recycled, including Fuel blending	16,770.72	26,997.5	30,183.2
	Incineration	13,936	8,799.7	11,217.5
	Treatment and Landfilled	39,591	61,410.8	51,034.4
	Total	70,297.72	115,133.8	121,014.3
Mexico	Metal Reclamation (emission control dust	71,596.78	75,851.6	104,408.2

	from electric arc furnace steel mills)			
Other Countries	Metal Reclamation	813.95	472.8	970.7
Totals		142,708.95	191,458.2	226,393.2

Source: Information provided to authors by U.S. EPA from EXPORTS Database

Table 14. Number of Waste Streams and Waste Notices of Exports, 1993-1999

Country	1993	1994	1995	1996	1997	1998	1999
Canada-Notices	489	477	580	720	675	768	772
Canada-Waste Streams	1042	1398	2144	2709	3333	3580	4856
Mexico-Notices	15	22	30	22	27	28	28
Mexico – Waste Streams	15	22	30	22	27	28	35
Other – Notices	22	20	28	12	9	10	16
Other-Waste Streams	28	20	30	12	10	23	17
Totals – Notices	526	519	638	754	711	806	816
Totals-Waste Streams	1085	1440	2204	2833	3370	3631	4901

Source: Information provided by U.S. EPA, 2000 from Exports and WITS Database

Table 15. 1997 and 1998 Consignees in Canada and Mexico Receiving U.S. Hazardous Waste

Country	Facility Name	Description
Canada	1. Safety Kleen	Solvent recovery
	2. Stablex	Treatment and landfilling
	3. Noranda	Copper smelter
	4. Cominco	Zinc, lead smelter
	5. Inco	Nickel smelter
	6. Toxco	Lithium battery recycling
	7. Nova PB	Secondary lead recycling
	8. Chem Rec	Solvent recycling
	9. Services Sanitaire De Recyclage	
	10.Philip Environmental	
	11. Centre de Recyclage Intermediare	Physical chemical treatment, Recycling
	12. Lynx Environmental Services	
	13. Cyanide Destruction Systems	
	14.Republic Environmental Systems	

	15. Laidlaw, Ontario 16. Laidlaw, Quebec 17.Falconbridge 18.Thermonic 19.Hotz. Env 20. Chem King 21.Tonolli	 Physical/chemical treatment, Incineration Physical chemical treatment Nickel smelter Metal recovery Solvent recycler
Mexico	Zinc Nacional, Monterrey *Accumex* *Metales Potosí*	Metal Recovery Battery Recovery Battery Recovery

Note: Italicized consignees did not report to database, but are believed to receive U.S. hazardous waste.

U.S. EPA, Exports Database, information provided to authors.

Table 16. Number of Waste Streams and Waste Notices of Imports, 1995-1999

	1995	1996	1997	1998	1999
Canada Import Notices	660	682	784`	536	519
Waste Streams	2650	2170	1597	1530	1735
Mexico-Import Notices	NA	28	53	2	6
Waste Streams	NA	28	53	6	15
All Countries Import Notices	823	864	1162	824	745
All Countries Waste Streams	2813	2354	1975	1819	1971

All countries include data from Malaysia, Costa Rica, Taiwan and OECD members.
Source: Information provided by U.S. EPA to authors from WITS Database.

Table 17. Tons of RCRA hazardous waste, total Solid Waste and Number of RCRA Hazardous Waste Manifests received from Mexico, 1993-1997

Category	1993	1994	1995	1996	1997
Tons of RCRA Hazardous Waste	9437	10,133	8,510	6,893	11,057
Number of RCRA Manifests	2208	2,857	2,594	2,609	4,303

Total Solid Waste	21,768				31, 709
RCRA Waste Managed at Texas TSD Facilities	3,248.44	NA	3,843.57	NA	5,661.55

Source: U.S. EPA, HAZTRAKS Database, 1998 and TNRCC, TRACS Database.

Table 18. Amount of RCRA Hazardous Waste Shipped to U.S. by Border Cities, 1997

City of Origin	Number of Maquilas in City, 1997	Number of Companies in Haztraks Database that Shipped Solid Waste, 1997	Tons of Hazardous Waste to U.S., 1997
Reynosa	94	13	252
Nuevo Laredo	52	8	23
Matamoros	113	21	400
Tijuana	628	290	5,803
Mexicali	158	71	1,258
San Luis	28	2	130
Nogales	74	35	137
Agua Prieta	32	10	67
Ciudad Juárez	289	246	2,066
Ciudad Acuña	53	3	1
Piedras Negras	45	2	0
Total Border Cities	1,566	701	10,137
Other Cities in Border States	436	88	920
TOTAL	2,002	789	11,057

Source: Column II: INEGI, Estadísticas de la Industria Maquiladora de Exportación, December 1997;
Column III: Query Run on U.S. Environmental Protection Agency, HAZTRAKS Database, 1998.
Column III: U.S. Environmental Protection Agency, Region 6, HAZTRAKS Web Page, April 1999.

Table 19. Government Regulations and Actions regarding Hazardous Waste since 1994

Regulation or Action	Description	Outcome
NOM-087-ECOL-95	Establishes requirements for separation, packaging, storage, collection, transport, treatment and final disposal of medical hazardous waste.	Has led to over 3,000 medical facilities having to manage their wastes as well as an increase in incinerators and other medical waste management facilities
March 1996 Agreement with Cement Industry	Allowed for temporary authorization for incineration in cement kilns	Despite lack of official standard, has allowed virtually all cement plants in Mexico to burn liquid and solid hazardous waste.

November 1998 Aviso de Retorno System and creation of SIRREP database	Mexico announced that Maquiladoras no longer needed to obtain "Guia Ecologicas" but could instead simply tell the authorities when they were returning hazardous wastes	Has led to a more accurate count of hazardous waste from Mexico but has decreased obligations and oversight.
Environmental Emergencies Branch (DGEA)	As per 1996 amendments, created a government entity and center to provide information and gather statistics on industrial accidents, and enforce rules	Led to much better statistical information on industrial accidents as well as governmental response.
NMX-XXX-SCFI-1999 Voluntary Pollutant Release and Transfer Registry, List of Substances and Reporting	Industries must report information to INE about air emissions; however, information about hazardous waste and toxic emissions is strictly voluntary.	Led to Mexico's first PRTR report, but only 5% of the participating industries actually supplied any voluntary data, and many industries did not participate at all.

Table 20. Proposed Standards in Mexico Related to Hazardous Waste, 2000

Name	**Status**
NOM–101–ECOL, Establishing requirements for used lubricant treatment and recylcing	Currently in revision
NOM–xxx–ECOL, establishing characteristics and for management of PCBs	Approved by subcommittee
NOM–xxx–ECOL, regulating the incineration of hazardous waste.	Undergoing Public Comment Period

Source: INE, website.

Table 21. Number of Industrial Inspections and Environmental Compliance Rates Over Time, 1994-99

Year	1994	1995	1996	1997	1998	1999
Inspections	12,902	12,881	13,224	11,761	9,590	8,671
% Without Violations	20.6	27.6	25.1	20.6	21.7	20.2
% With Minor Violations	75.7	70.3	72.9	77.4	76.7	78.1
% With Major Violations	4.1	2.1	1.9	2.0	1.6	1.7

Source: PROFEPA, Indices de Cumplimiento de la Normatividad en Mexico (January 1999), Graphic 4.

Table 22. Inspections and Compliance Rates, Border States vs. Nation, August 1992 – June 2000

Category	All Border Facilities	Maquiladoras	Entire Nation
Total Number of Industrial Inspections	20,768	6,911	91,879
Total Shutdowns	200	29	571
% Shutdowns	1.0 %	0.4%	0.6%
Partial Shutdowns	519	172	2,104
% Partial Shutdowns	2.5 %	2.5%	2.2%
Total With Minor Violations	16,238	5,154	69,700
% with Minor Violations	78.1%	74.5%	75.9%
Total without Violation	3,811	1,556	19,504
% Without Violations	18.3%	22.5%	21.2%

Source: Subprocuraduria de Verificacion Industrial, PROFEPA, Website

Table 23. Number of Environmental Audits, 1992 – May 2000

Name of Company	Audits in Process	Audits Completed	Total
CEMEX	0	20	20
FNE (National Railroads)	0	82	82
Grupo Penoles	0	15	15
General Motors	0	60	60
PEMEX	5	289	294
CFE (Federal Electricity Commission)	0	33	33
Ford Motors	0	14	14
ASA	0	70	70
Other Private Companies	41	470	511
Private Companies Paid for by PROFEPA	0	340	340
Total	46	1393	1439

Source: PROFEPA, Information from Website, 2000.

Table 24. Average Compliance Rates (ICNA) in Mexico for Hazardous Waste Generators and Management Companies, 1998-2000

Category	# of Facilities Assessed	Average Rate of All Facilities (%)	Average Rate of Large Facilities (%)	Average Rate of Medium Facilities (%)	Average Rate of Small Facilities (%)	Average Rate of Micro Facilities (%)
Hazardous Waste	4,077	52.1	61.8	59.0	54.9	35.3

Generator						
Hazardous Waste Management Company	259	43.9	NR	NR	NR	NR
Medical Waste Management Company	1,165	60.0	60.5	59.8	61.6	59.1

Source: PROFEPA 1999: Figures 7 and 8.

Table 25. Abandoned and Illegal Hazardous Waste Sites, 1995-1997

State	***No. of Sites***	***Principal Wastes***
Baja California	8	Solvents, heavy metals, foundry dust, oils
Chihuahua	13	Hydrocarbons, chemical compounds, used oils
Coahuila	15	Heavy metals, tailings, used oil, hydrocarbons, biological/infectious, chemical compounds
Nuevo León	22	Foundry slag, aluminum, lead, cadmium, nickel, oil, cyanides, hydrocarbons
Tamaulipas	8	Foundry slag, sand silica oils, phenols, chemical compounds, empty containers
Total nacional	166	

Source: PROFEPA, Triannual Report, 1995-1997, 1998, Chapter V, Table 1.

Table 26. Number of Industrial Accidents in Mexico, 1994-1999

State	1994	1995	1996	1997	1998	1999
Baja California	17	9	10	18	9	8
Chihuahua	15	22	17	11	5	4
Coahuila	11	28	25	27	16	14
Nuevo Leon	15	18	19	20	28	14
Sonora	15	14	20	25	20	10
Tamaulipas	28	23	17	10	7	9
All Mexico	416	547	587	632	538	469

Source: Information from PROFEPA Website.

Table 27. Cement Plants which Burned Hazardous Waste in Mexico, 1997

Cement Company	No. of Plants	No. of Plants Burning Haz. Wastes	Amount Burned in Tons, 1997
CEMEX	18	5	23,000
Apasco	6	6	20,000
Cruz Azul	2	2	17,000

Moctezuma	2	1	11,000
Cementos de Chihuahua	3	0	0
TOTAL	31	14	71,000

Notes: Each plant receives its "alternative waste" from different sources. Cementos de Chihuahua currently does not burn hazardous wastes or tires, but does have a permit to test burn hazardous wastes and recently was granted a permit to blend fuels at its plant in Samalayuca.

Source: Dr. Ramón Farías, Director of Energy, CEMEX, Speech Given at US-Mexican Foundation for Science Conference, Monterrey, Mexico, September 11, 1998.

Table 28. Hazardous Waste Landfills Which Had Operating Permits in Mexico, 1998

Facility Name	Location
Ciba-Geigy	Atotonilquillo, Jalisco
CONFIN*	Guadalcazar, San Luis Potosí
RIMSA	Mina, Nuevo León
CYTRAR**	Hermosillo, Sonora

.

Source: Instituto Ecologico de Mexico, Information from web page (http://www.ine.gob.mx/dgmrar/ri/list-ea/rubro7.htm), April 1999.

Table 29. Total Public Investment in Environmental Protection, and Solid Waste Management, 1990-1996 (Thousands of Dollars)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Capital Investment							
Solid Wastes 2	127 536	36 067	52 560	21 837	51 257	28 421	22 740
Total Environmental Investment	393 891	291 819	367 970	439 410	427 344	248 895	262 896
Operating Investment							
Solid Wastes 2	4 348	147 945	219 318	239 362	223 677	124 780	122 195
Total Environmental Investments3	492 217	784 560	1 058 368	1 324 199	1 406 648	700 843	682 114
Total Investment							
Solid Waste 2	131 884	184 012	271 878	261 199	274 934	153 201	144 935
Total Environmental Investment 3	886 107	1 076 379	1 426 338	1 763 609	1 833 991	949 738	945 010

1. The figures cover the primary expenditures of public investment in environmental protection, including the Federal Governement, State Governments, and Mexico City. Parastatal companies such as Petroleos Mexicanos (PEMEX) and Comisión Federal de Electricidad are also included.
2. This includes the collection, treatment and management of all wastes, including municipal, industrial, hazardous and others.
3. In addition to the investment in waste management, total investments include water, soils, air and other.

Source: INEGI, using information from the Federal Budget (Presupuesto de Egresos de la Federación) and Federal Public Treasury Account (Cuenta de la Hacienda Pública Federal) for the years covered. Figures prepared by SEMARNAP for a report to the OECD on investment in pollution abatement and control.

Note: The information available on public investment in waste treatment is still too aggregated for meaningful analysis. Treatment and collection are listed, without information on whether the wastes are hazardous, industrial non-hazardous, municipal or other. Neither is there any break-out information on investment in equipment, operation, maintenance, fuels or salaries.

Table 30. Public Expenditure in Environmental Protection as Percentage of Gross Domestic Product, 1990-1998
(Millions of Pesos at Non-Adjusted Prices)

Year	**Gross Domestic Product 1**	**Environmental Protection Expenditures 2**	**Protection/GDP (%)**
1990	676 067.0	2 536	0.38
1991	868 219.2	3 248	0.37
1992	1 029 004.6	4 414	0.43
1993	1 155 132.2	5 494	0.48
1994	1 306 301.6	6 190	0.47
1995	1 678 834.8	6 096	0.36
1996	2 296 674.6	7 182	0.31
1997	2 873 273.0	7 934	0.28
1998	3 516 344.8	8 643	0.25

1 GDP in basic values.
2 Refers to those categories of the budget actually spent, eliminating those that were budgeted but never carried out, as well as those which did not directly relate to environmental protection.
Source: INEGI, Sistema de Cuentas Económicas y Ecológicas de México, 1988-1998, México 2000.

Table 31. Geographic Distribution of Hazardous Waste Collection, Storage and Management Facilities in Mexico

State or Region	Collection and Transport	Storage	Reuse	Recycling	Treatment	Burning (1)	Landfills	Total
Number of Permits or Authorizations								
Baja California	25	9	0	8	0	2	0	44
Coahuila	12	0	0	5	1	2	0	20
Chihuahua	17	6	0	2	0	0	0	25
Nuevo León	61	14	0	17	4	1	1	98
Sonora	3	2	0	3	0	0	0	8
Tamaulipas	16	8	0	1	4	0	0	29
Total Border	134	39	0	36	9	5	1	229

Total nacional	262	82	4	119	40	37	2	546

Note; Burning includes incinerators, cement kilns and aggregate kilns. Fuel blending is considered in treatment.
Source: INE, as reported in website (http://www.ine.gob.mx/dgmrar/ri/infra-rip.htm,) with some information updated.

Table 32. Increase in Authorized Facilities in Hazardous Waste Management, including Medical Waste, 1992-1999

Permits and/or Authorizations	**'92**	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**Tot**
Reuse of used solvents	0	1	0	0	0	0	1	3	0	5
Recycling of used drums	0	1	3	0	0	1	16	13	5	39
Recycling of dirty solvents	0	4	5	1	1	1	7	2	3	24
Recycling of photographic fixing liquid	0	0	0	0	0	0	1	3	1	5
Recycling of used lubricants	0	2	2	2	1	3	1	4	0	15
Recycling of metals	0	0	3	1	0	2	5	5	2	18
All Recycling and Reuse Facilities	**0**	**8**	**13**	**4**	**2**	**7**	**31**	**30**	**11**	**101**
Fuel Blending Plants	0	1	2	0	0	0	5	9	2	19
Treatment of PCB contaminated materials	0	0	0	2	1	2	1	0	0	6
Treatment of remnants on-site	0	1	11	1	0	0	4	16	2	35
Treatment of infectious biological remnants	0	0	0	0	0	0	8	11	4	23
Treatment of dangerous remnants	0	1	0	0	1	1	3	5	5	16
All Treatment Facilities	**0**	**2**	**11**	**3**	**2**	**3**	**16**	**32**	**11**	**80**
Incineration of alternative fuel	1	0	0	0	1	1	7	16	0	26
Incineration of dangerous remnants	0	1	0	0	0	0	3	3	2	9
Incineration of biologically infectious remnants	0	0	0	0	0	0	1	8	5	14
All Incineration Facilities	**1**	**1**	**0**	**0**	**1**	**1**	**11**	**27**	**7**	**49**
Final Disposal	0	3	0	0	0	0	0	0	0	3

Totals	1	15	26	7	5	11	63	98	31	252

Note: Because some facilities perform more than one type of hazardous waste management, the total number of facilities is less than the total number of permits
Source: INE, information from website.

Table 33. Value-Added of Non-Renewable Manufacturing Industries in Mexico, 1990-1998
(Millons of 1993 pesos)

Sector	1994	1995	1996	1997	1998
Division V					
Chemicals, Petro-Chemicals, Plastics and Rubbers	36 270.1	35 935.0	38 297.0	40 910.7	43 374.1
Petroleum and Derivatives	5 061.9	4 736.2	4 786.7	4 725.1	4 968.0
Basic Petro-Chemicals	2 256.2	2 353.8	2 247.9	1 983.3	1 735.4
Chemicals	3 787.8	3 897.4	4 122.3	4 460.1	4 563.5
Fertilizers	489.5	565.9	635.5	549.1	483.2
Synthetic Resins	2 972.5	3 215.5	3 585.0	3 860.0	4 187.9
Pharmaceutical	5 861.0	6 628.1	7 001.5	7 827.4	8 382.4
Soaps, Detergents and Resins	4 556.0	4 251.4	4 377.7	4 694.2	5 084.3
Other Chemicals	4 341.0	3 903.7	4 275.7	4 721.0	5 335.7
Rubber Products	2 116.5	1 901.4	2 233.4	2 459.0	2 765.6
Plastics	4 827.7	4 481.6	5 031.4	5 631.5	5 868.1
Division VI					
Non-metallic Mining Products (Cement)	4 619.8	3 783.6	4 245.3	4 436.3	4 547.2
Division VII					
Basic Metallic Industries	10 304.9	10 724.6	12 736.1	14 154.0	14 720.1
Iron and Steel Industries	7 275.1	8 076.7	9 281.0	10 360.0	10 561.0
Other Basic Metal Industries	3 029.8	2 647.9	3 455.1	3 794.0	4 159.1
Total	**51 194.8**	**50 443.2**	**55 278.4**	**59 501.0**	**62 641.4**

Source: INEGI, **Sistema de Cuentas Nacionales de México 1988-1998**, México, 2000.
As Cited in **Indicadores de Desarrollo Sustentable en México. INEGI/SEMARNAP 2000.**

Table 34. Number of Active Maquiladora Plants by State and Year, 1990-2000

Year	National Total	Total Border States	Baja California	Coahuila	Chihuahua	Nuevo León	Sonora	Tamaulipas
1990	1 703	1527	640	133	311	65	155	225
1991	1 914	1820	708	151	336	79	161	259
1992	2 075	1828	775	172	351	82	170	278
1993	2 114	1850	804	176	337	84	168	279
1994	2 085	1801	761	177	304	83	179	297
1995	2 130	1776	729	184	322	84	176	281
1996	2 411	1973	793	212	371	99	192	307
1997	2 717	2204	904	244	402	110	222	323
1998	2 983	2367	1 018	261	383	119	245	342
1999	3 297	2552	1 125	272	401	131	263	360
2000 P	3506	2694	1174	278	448	150	277	367

Source: INEGI. Industria Maquiladora de Exportación. Estadísticas Económicas. Abril 2000.

Table 35. Average Monthly Value-Added Production and Imported Inputs of Maquiladora Plants in Mexican Border States
(Millions of Constant 1994 Pesos)

Year	Average Monthly Value-Added Production	Monthly Value of Imported Inputs	% of Inputs that were Imported
1994	1,516	5,594	99.1%
1995	1,704	11,243	98.9%
1996	1,857	17,124	99.6%
1997	2,268	22,146	98.6%
1998	2,637	26,401	98.3%
1999	3,000	40,450	98.2%
2000	3,074	33,916	98.4%

Source: INEGI, Industria Maquiladora de Exportacion. Estadisticas Economicas. Abril 2000.

Table 36. Companies which reported hazardous waste generation in Mexico, September 1999

	No. of Companies Reporting	**Generation (Ton/Year)**
BAJA CALIFORNIA	75	29,508.47
COAHUILA	1,020	2,359.34
CHIHUAHUA	203	779,223.06
NUEVO LEÓN	950	47,788.35
SONORA	545	4,082.00
TAMAULIPAS	409	218,576.20
All Border States	3,202	1,081,537.47
National Total	13,245	3,328,045.29

Source: Reported by INE in website (http://www.ine.gob.mx/dgmrar/ri/generacion.htm).

Table 37. Variation between 1994 Estimate of Hazardous Waste Generated in Mexico and 1999 Reported Hazardous Waste Generated in Mexico

	1994	Sep. 1999	Variation (94-97)	
State	**Estimated Hazardous Waste Generation (tons/year)**	**Reported Hazardous Waste Generation**	**Reduction in Tons**	**Increase in Tons**
Baja California	160,000	29,508.47	130,491.53	-
Coahuila	300,000	2,359.34	297,640.66	-
Chihuahua	210,000	779,223.06	-	569,223.06
Nuevo León	800,000	47,788.35	752,211.65	
Sonora	145,000	4,082.00	140,918.00	
Tamaulipas	150,000	218,576.20		68,576.20
All Border States	1,765,000	1,081,537.47	683,463	
Total Nation	8,000,000	3,328,045.29	4,671,954,8	

Source: For 1994: INE, Programa para la Minimización y el Manejo Integral de los Residuos Industriales Peligrosos en México. 1996-2000 and INE, website (http://www.ine.gob.mx/dgmrar/ri/generacion.htm), 2000.

As cited in: Indicadores de Desarrollo Sustentable en México. INEGI/SEMARNAP 2000.

Table 38. Hazardous Waste Generators Under Mexican Federal Jurisdiction: Number of Establishments per Industry

Sector	Size of establishments	Number of Facilities
Industries Automatically Under Federal Jurisdiction (Chemical, Basic Petrochemical, Petroleum, Pulp and Paper, Glass, Cement, Lime, Metallurgy, Automotive Manufacturing, Electrical Manufacturing, Paints and dye manufacturing, Asbestos)	All sizes, but mainly Medium and Large	9,955
Hazardous waste shipping, storage, treatment, recycling, incineration or disposal	Small, Medium and Large	270
Industries under Federal Jurisdiction Because of Production of Hazardous Wastes		
Hospitals (production of medical wastes)	Small, Medium and Large	3,140
Metalwork	Small, medium and large	5,318
Maquiladoras	All sizes	2,140

Printing	Small, medium and large	1,177
Textiles	Medium and large	1,093
Furniture production	Small, medium and large	1,081
Tanning	All sizes	1,014
Food and beverages	Medium and large	995
Automotive repair and maintenance	Small, medium and large	725
Fumigation services	All sizes	443
Plastics	Medium and large	266
Ports, airports and truck depots	All sizes	222
Ore concentration	All sizes	188
Other manufacturing facilities	Medium and large	30
Non-metallic minerals	Medium and large	20
TOTAL		**14,712**

Source: PROFEPA, Triannual Report, 95-97, 1998, Tables 1 and 2.

Table 39. Estimates of Hazardous Waste Generated by Sector, 1996

Waste Types	Ton/Year
Solvents	248,954.82
Used Oils	319,706.65
Liquid Residuals	361,455.76
Corrosive Substances	157,070.59
Sludge	223,720.18
Solids	498,341.32
Tars and Resins	1,038.31
Slags	258,690.32
Medical	655.61
Biological or infectious	4,654.07
TOTAL	2,074,287.63

Source: INE, as cited in "Promoción de la Minimización y Manejo Integral de los Residuos Peligrosos". Dirección General de Materiales, Residuos y Actividades Riesgosas. October 1999.

Table 40. Estimated Generation of Hazardous Waste by Sector, 1996

Subsector	**DESCRIPTION**	**Tons/year**	**% of Hazardous Wastes Generated**
00	Unknown	148,180.56	7.1437%
11	Agriculture and Cattle	16,490.34	0.7950%
13	Fishing	120.89	0.0058%
22	Petroleum and Natural Gas Extraction	51,189.53	2.4678%
23	Metal Mining	113,073.23	5.4512%
29	Non-Metal Mining	65,218.75	3.1442%

Subsector	DESCRIPTION	Tons/year	% of Hazardous Wastes Generated
31	Food, and Food-Processing	146,782.61	7.0763%
32	Textiles, including leather products	8,285.99	0.3995%
33	Wood Industry	18,050.29	0.8702%
34	Paper and Paper Products	13,385.65	0.6453%
35	Chemicals, Petro-chemicals, Rubber and Plastics	774,479.51	37.3371%
36	Non-metallic Mineral Products	165,688.03	7.9877%
37	Basic Metal Industry	152,840.42	7.3683%
38	Metal Products, Machinery and Equipment	314,286.32	15.1515%
39	Other Manufacturing Industries	5,172.25	0.2494%
41	Electricity	589.62	0.0284%
50	Construction	58.81	0.0028%
61	Commerce, Wholesale	52,423.36	2.5273%
62	Commerce, Retail	5,533.56	0.2668%
71	Transport	1,244.62	0.0600%
83	Renting and Housing Services	143.70	0.0069%
92	Education, Medical, Social Assistance Services	13,529.67	0.6523%
93	Restaurants and Hotels	0.75	0.0000%
94	Sport and Recreation Services	3.92	0.0002%
95	Professional Services	40.39	0.0019%
96	Repair and Maintenance Services	6,849.24	0.3302%
97	Agriculture, Cattle, Construction, Transport, Financial and Business Services	178.50	0.0086%
99	Not Defined	447.12	0.0216%
TOTAL		2,074,287.63	100.0000%

Source: INE, 1997 as cited in Indicadores de Desarrollo Sustentable en México. INEGI/SEMARNAP 2000.

Table 41. Imports of Hazardous Wastes from the U.S to Mexico, 1995-1999

Year	Tons of Hazardous Waste
1995	158,543
1996	230,417
1997	223,713
1998	284,921
1999	254,537

Source: INE, website and as cited in Binational Solid and Hazardous Waste Working Group Border XXI, Progress Report, Unpublished, Figure 7.

Table 42. Exports of Hazardous Wastes by Maquiladoras and National Industry, 1995 –1999

Year	Tons of Hazardous Waste Exported by Maquiladoras to U.S.	Tons of Hazardous Waste Exported by National Industry to U.S.	Total Hazardous Waste Exported Mexico to U.S.
1995	33,187	5,753	38,940
1996	72,982	5,079	78,061
1997	77,692	9,950	87,642
1998	83,469	21,282	104,751

1999	51,704*	31,828	83,532

Note: * This year, the number was generated by a new computer tracking system known as SIRREP, which reports actual shipments rather than the amount permitted to be shipped.
Source: INE, website and as cited in Binational Solid and Hazardous Waste Working Group Border XXI, Progress Report, Unpublished, Figure 4.

Table 43: Environment Canada Enforcement of CEPA Hazardous Waste Import/Export Regulations.

Year	Inspections	Investigations	Warnings	Prosecutions	Convictions	Acquittals
1994/1995	170	11	8	1	1	
1995/1996	158	15	4	9	1	
1996/1997	153		4	2		
1997/1998	362	7	4	2	1	

Source: CEPA Annual Reports, 94-98.

Table 44. Imports of Hazardous Waste to Canada by Province, 1993-1999

		AB	BC	MB	NB	NS	ON	PQ	SK	Canada
1993	Recycling									
	Disposal									
	Total						56,439	71,727		132,992
1994	Recycling									246,359
	Disposal									95,806
	Total						129,118	205,587		342,165
1995	Recycling									272,025
	Disposal									111,109
	Total							229,497		383,134
1996	Recycling	287	11,364		258		95,691	203,593	389	247,305
	Disposal	0	46		0		94,726	60,260	0	219,309
	Total	287	11,410		258		190,417	263,853	389	466,614
1997	Recycling						88,365	176,952		272,917
	Disposal						158,000	56,434		214,434
	Total	343	6,669		589		246,365	233,386	0	487,351
1998	Recycling	415	1,696		311		114,543	194,289	2,997	314,252
	Disposal	0	329		0		173,511	57,281	0	231,120
	Total	415	2,025		311		288,054	251,570	2,997	545,372
1999	Recycling	226	2,241	0	1,621		84,642	181,958		270,688
	Disposal	0	1,029	75	0		239,912	151,189		392,205
	Total	226	3,270	75	1,621		324,554	333,147		662,893

Table 45. Exports of Hazardous Waste from Canada by Province, 1993-1999

		AB	BC	MB	NB	NS	ON	PQ	SK	Canada
1993	Recycling									
	Disposal									

	Total					156,945	29,387		229,648
1994	Recycling								94,211
	Disposal								74,023
	Total								168,234
1995	Recycling								126,554
	Disposal								99,435
	Total	4,520	27,797	16,045	6,780	452	98,305	71,413	678	225,989
1996	Recycling								93,009
	Disposal								104,882
	Total								197,891
1997	Recycling								153,294
	Disposal								98,008
	Total	5,934	53,935	18,483	17,746	776	110,846	43,565	17	251,302
1998	Recycling	11,968	13,843	25,708	21,000	841	83,783	49,527	1,143	207,813
	Disposal	460	5,309	3,492	0	71	40,640	25,025	0	74,997
	Total	12,428	19,152	29,200	21,000	912	124,423	74,552	1,143	282,810
1999	Recycling	8,089	11,130	18,440	9,759	179	96,267	61,188	910	205,962
	Disposal	63	2,346	1751	0	0	27,592	30,217	0	61,969
	Total	8,152	13,476	20,191	9,759	179	123,859	91,405	910	267,931

Table 46. Spot Exchange Rate Canadian $ / US $ based on March 31's exchange rates for each year

Year	Rate
1980	1.1915
1981	1.1873
1982	1.2305
1983	1.2341
1984	1.2766
1985	1.3675
1986	1.397
1987	1.3053
1988	1.2342
1989	1.1936
1990	1.1705
1991	1.1595
1992	1.1902
1993	1.2573
1994	1.3838
1995	1.3993
1996	1.3635
1997	1.3835
1998	1.418
1999	1.5092
2000	1.4538

Table 47. Hazardous Waste Generation in Key Exporting States 1991-1997

	HAZARDOUS WASTE QUANTITY				
Michigan	Rank	Tons generated	Percentage	number of generators	Percentage
1991	2	31,862,518	10.4	755	3.2
1993	4	21,014,255	8.1	789	3.2
1995	4	13,446,389	6.3	718	3.4
1997	10	994,047	2.4	682	3.4
New York					
1991	5	18,036,041	5.9	2,627	11.2
1993	16	1,498,421	0.6	2,036	8.4
1995	11	2,306,232	1.1	2,144	10.3
1997	15	419,899	1	2,772	13.6
Ohio					
1991	16	1,809,547	0.6	1,542	6.6
1993	15	1,739,928	0.7	1,524	6.3
1995	13	1,823,547	0.9	1,373	6.6
1997	4	1,693,247	4.2	1,271	6.3

Table 48. Tons of Electric Arc Dust Hazardous Waste (Code K061) Produced by Selected Steel Mills and Tons Shipped to Mexico, 1993 -97

Company		1993 Total	1995 Total	1997 Total
Nucor Yamato Steel, Arkansas	TOTAL	23,754	33,973	50,822
	Sent to Mexico	0	0	4,823
Nucor Steel, Texas	TOTAL	7,396	10,640	11,927
	Sent to Mexico	6,949	9,042	11,491
Bethlehem Steel, Pennsylvania	Total	11,282	13,949	17,026
	Sent to Mexico	0	0	0
Chapparal Steel, Texas	Total	21,298	21,915	20,523
	Sent to Mexico	9,856	13,040	12,253

Source: EPA, Biennial Hazardous Waste Reporting System

Figure 1: Hazardous Waste Imports to Canada and Canadian/US Dollar Exchange Rates.

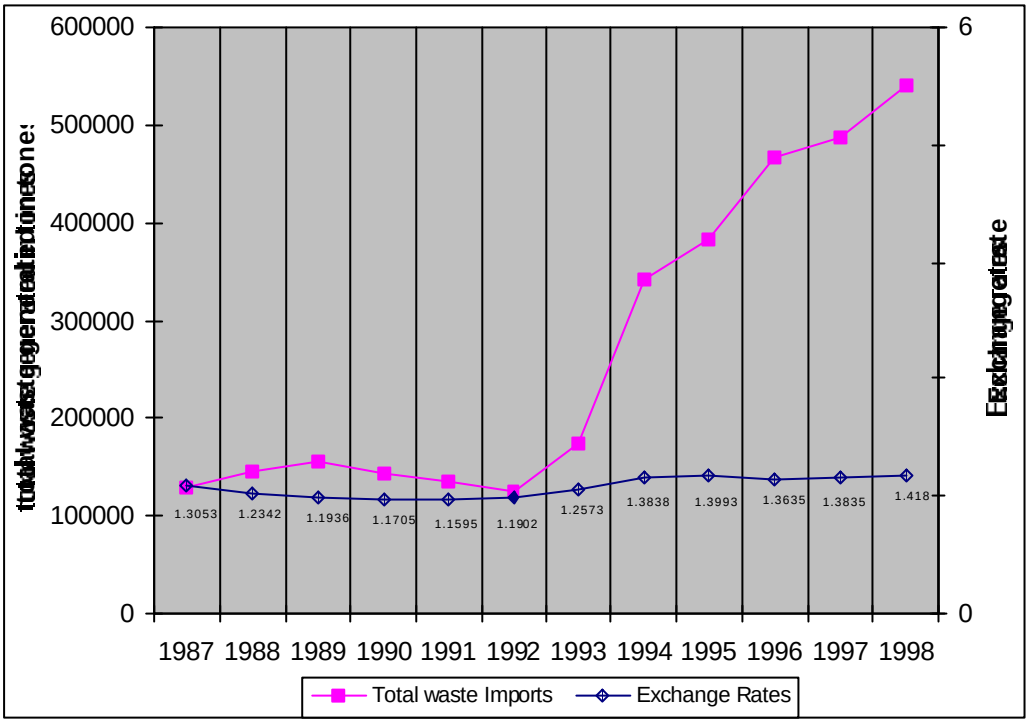

Figure 2: Hazardous Waste Management Regulation in Ontario and the United States

ENVIRONMENTAL PROTECTION REQUIREMENT	US	ONTARIO
Companies that produce or generate hazardous wastes must		
* register with environmental protection authorities	Yes	Yes
* report annually or biannually to environmental protection authorities	Yes	No
* follow strict and detailed on-site hazardous waste identification and storage requirements (including emergency planning requirements for large quantity generators)	Yes	No
Companies that transport hazardous wastes must		
*complete a manifest detailing materials being transported and destination	Yes	Yes
*immediately take measures to contain an accidental spill and report accidental spills to authorities	Yes	Yes
Companies that store, treat, and dispose of hazardous wastes must		
*apply for permission (by permit or certificate of approval) to operate	Yes	Yes
*provide financial assurance against environmental harm as part of permitting process	Yes	Yes

*have insurance against accidental liability	Yes	No
*analyse all incoming waste to ensure that it conforms both to the description on the waste manifest and to the categories of waste the site is permitted to receive	Yes	Yes
*make biennial reports on quantities and kinds of wastes received	Yes	No
*provide for groundwater quality monitoring in the area of the site	Yes	No
*have a plan in place to deal with emergencies	Yes	No
*control all dispersion by wind and rainwater of hazardous materials	Yes	No

Environmental protection authorities require by law that

*no permit is issued without full and ongoing public involvement in decision-making about the placement and operations of hazardous waste treatment storage and disposal sites	Yes	No1
*hazardous wastes are treated before they are disposed in landfill	Yes	No
*financial assurances reflect the cost of 'most expensive closure'	Yes	No
*information received from waste generators and waste treatment facilities is published in publicly-available documents every two years	Yes	No

The environmental protection authority has legal standards for

*Hazardous Waste Containers	Yes	No
*Hazardous Waste Storage Tanks	Yes	No
*Hazardous Waste Containment Buildings	Yes	No
*Hazardous Waste Land Treatment Units	Yes	No
*Hazardous Waste Surface Impoundments and Waste Piles	Yes	No
*Hazardous Waste Incinerators, Boilers and Industrial Furnaces	Yes	No

1Public involvement in Ontario is limited to what rights may be available under environmental assessment legislation and/or the Environmental Bill of Rights

TABLES FROM APPENDIX A

Table 1. Major Companies in the Commercial Hazardous Waste Industry, Number of RCRA-approved Facilities in 1994 in the U.S.

Name of Company	Recovery Facilities	Treatment Facilities	Incineration	Landfills	Disposal Wells
Chemical Waste Management	1	13	2	8	3
Laidlaw Environmental Services	6	10	3	2	
Rhone-Poulenc		1	3		
Rollins Environmental Services		2	3	1	1
Aptus, Inc.			2		
U.S. Ecology		1		1	
Envirosafe		1	1	2	
USPCI	2	4	2	1	
Burlington Environmental Services	3	6	1		
Safety Kleen	8	9			
Oldover		2			
Systech		3			

Source: Table calculated from U.S. EPA, National Capacity Assessment Report (US EPA: 1995), Appendix D.

Table 2. Cement Companies which burned hazardous wastes in the U.S.., 1993

Name of Company	Number of Plants	Locations
Keystone Cement Company	1	Pennsylvania
Medusa Cement	1	Pennsylvania
Solite Cement	5	Virginia (2), Florida, N. Carolina, Kentucky
Lafarge	4	Alabama, Michigan, Ohio, Kansas
Holnam	3	Mississippi, S. Carolina, Missouri
National Cement	1	California
Giant Cement Company	1	South Carolina
Dixie Cement Company	1	Tennessee
ESSROCH Cement	1	Indiana
Heartland Cement	1	Kansas
Continental Cement	1	Missouri
Ash Grove	3	Arkansas, Kansas, Nebraska

River Cement	1	Missouri
TXI	1	Texas
Lone Star	2	Indiana, Missouri
Total Cement Plants with RCRA authorization in 1994	27	

Source: Table calculated from U.S. EPA, National Capacity Assessment Report (US EPA: 1995), Appendix D.

Table 3. 1991 Management and Capacity of Hazardous Wastes in Commercial Systems and Expected Demand and Capacity in 2013

Management Method	1991 Demand	End of 1991 Capacity	2013 Demand	Maximum 2013 Capacity
RECOVERY				
Metals	800,000	2,000,000	800,000	1,800,000
Inorganics	100,000	450,000	96,000	370,000
Organics	610,000	2,400,000	610,000	2,500,000
TREATMENT				
Stabilization	500,000	5,100,000	1,400,000	8,100,000
Combustion-Liquids and Gases	1,200,000	3,800,000	1,200,000	2,800,000
Combustion-Solids and Sludges	250,000	1,100,000	570,000	1,300,000
Fuel Blending	740,000	4,200,000	830,000	4,300,000
Wastewater & Sludges	2,900,000	38,000,000	3,200,000	40,000,000
DISPOSAL				
Landfill	1,600,000	43,000,000	1,930,000	45,000,000
Deepwell/Underground Injection	830,000	3,300,000	700,000	3,300,000
Land Treatment/Farming	7,400	0	NA	NA
TRANSFERS/STORAGE				
Transfer/Storage	50,000	NA	NA	NA
TOTALS	9,587,400	102,250,000	11,336,000	109,470,000

Source: U.S. EPA, National Capacity Assessment Report (US EPA: 1995), Tables II-V.

Table 4. 1994 Commercial Treatment and Disposal Facilities of RCRA Hazardous Waste by State and EPA Region

State/Region	Recovery Facilities	Combustion Facilities	Treatment Facilities	Disposal Facilities	Total Number Of Facilities
Connecticut	2	0	6	0	8
Massachusetts	5	0	3	0	8
Maine	0	0	1	0	1
New Hampshire	0	0	0	0	0
Rhode Island	3	0	2	0	3
Vermont	0	0	0	0	0
Region I Totals	10	0	12	0	20

New Jersey	8	1	9	0	14
New York	10	4	9	1	19
Puerto Rico	1	0	2	0	2
Region II Totals	19	5	20	1	35
Delaware	0	0	0	0	0
Maryland	0	0	1	0	1
Pennsylvania	11	2	6	0	18
Virginia	3	2	1	0	6
West Virginia	0	0	1	0	1
Region III Totals	14	4	9	0	26
Alabama	3	2	5	1	8
Florida	6	1	4	0	9
Georgia	3	0	4	0	5
Kentucky	3	2	5	0	8
Mississippi	1	1	1	0	2
N.Carolina	1	1	4	0	6
S.Carolina	4	4	3	1	9
Tennessee	5	1	4	0	8
Region IV Totals	26	12	30	2	55
Illinois	12	2	11	2	20
Indiana	11	3	6	1	19
Michigan	13	1	9	1	22
Minnesota	4	0	2	0	4
Ohio	14	4	21	2	27
Wisconsin	3	1	6	0	10
Region V Total	57	11	55	6	102
Arkansas	1	2	1	0	3
Louisiana	10	4	4	3	17
N. Mexico	2	0	0	0	2
Oklahoma	3	1	4	2	4
Texas	16	5	12	7	30
Region VI Total	32	12	21	12	56
Iowa	1	0	1	0	2
Kansas	1	4	4	0	6
Missouri	4	6	9	0	19
Nebraska	0	2	0	0	2
Region VII Total	6	12	14	0	29
Colorado	2	0	3	1	3
Montana	1	0	0	0	1
North Dakota	0	0	0	0	0
South Dakota	0	0	0	0	0
Utah	1	2	1	1	4
Wyoming	0	0	0	0	0
Region VIII Total	4	2	4	2	11
Arizona	5	0	5	0	7
California	30	1	11	4	42
Hawaii	1	1	1	0	1
Nevada	1	0	2	1	2
Region IX Total	37	2	19	5	52
Alaska	0	0	1	0	1

Idaho	0	0	1	1	2
Oregon	1	0	2	1	3
Washington	8	0	6	0	11
Region X Total	9	0	10	2	17
GRAND TOTAL	*214*	*60*	*194*	*30*	*403*

Note: Recovery Facilities include metal, organic and inorganic recovery; combustion includes incineration in cement kilns, commercial incinerators and aggregate kilns; Treatment Facilities include fuel blending, wastewater treatment and stabilization; Disposal Facilities include landfills and deepwell/underground injection wells. Totals do not add because many facilities operate more than one management method.

Source: Table calculated from U.S. EPA, National Capacity Assessment Report (US EPA: 1995), Appendix D.

Table 5. Hazardous Waste Generation in the U.S., 1991 –1993

	1991	1993
Large Quantity Generators	23,423	24,350
Tons Generated	305,708,881	258,449,001
Tons Generated by Top 50 LQGs	248, 619, 287	211,772,570

Source: U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1993 Data), August 1995 and U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1991 Data), April 1994.

Table 6. Hazardous Waste Managed in the U.S., 1991-1993

	1991	1993
Number of TSDs	3,862	2,584
Number of Non-storage TSDs	1,203	1,032
Number of Off-site TSDs	427	432
Tons of Hazardous Waste Managed in TSD facilities	294,437,307	234,864,033
Tons of Non-Wastewater Managed in TSD facilities	8,871,379	14,946,832
Tons of Hazardous Waste Managed in Off-site TSDs	7,690,516	8,309,165

Source: U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1993 Data), August 1995 and U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1991 Data), April 1994.

Table 7. Tons of RCRA Hazardous Waste Managed Off-Site by Year and Management Method

	1991		1993	
	Tons Managed	Percentage	Tons Managed	Percentage

Management Method				
Metals Recovery (For Reuse)	692,778	9	440,894	5.3
Solvents Recovery	463,447	6	430,519	5.2
Other Recovery	199,200	2.6	118,600	1.4
Incineration	452,235	5.9	487,576	5.9
Energy Recovery (Reuse as fuel)	533,868	6.9	920,579	11.1
Fuel Blending	1,033,329	13.4	956,303	11.5
Aqueous Inorganic Treatment	475,239	6.2	577,667	7
Aqueous Organic Treatment	298,511	3.9	178,809	2.2
Aqueous Org & Inorg Treatment	293,922	3.8	44,527	0.5
Sludge Treatment	6,550	0.1	4,606	0.1
Stabilization	758,611	9.9	707,883	8.5
Other Treatment	783,440	10.2	903,393	10.9
Land Treatment/Farming	642	0	57,546	0.7
Landfill	1,228,710	16	1,732,070	20.8
Surface Impoundment	8,477	0.1	No data	No data
Deepwell/Underground Injection	425,720	5.5	701,719	8.4
Other Disposal	35,837	0.5	44,605	0.5
Unknown System Due to Invalid Code	1	0	1,869	0
Total	7,690,516	100	8,309,165	100

Source: U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1993 Data), August 1995 and U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1991 Data), April 1994.

Table 8. Percentage of Hazardous Waste Managed and Generated by State and Region, 1991-1993

State or Region	% Generated, 91	% Generated, 93	% Managed, 91	% Managed, 93
Texas	34%	24.6%	35.3%	22.4%
California	4.2%	5.4%	4.1%	5.4%
All Mexico Border States (1)	38.4%	30.2%	39.5%	27.9%
Michigan	10.4%	8.1%	10.8%	8.8%
Ohio	0.6%	0.7%	0.6%	0.7%
Pennsylvania	0.6%	3.7%	0.5%	3.9%
Washington	4.8%	5.6%	3.6%	4.3%
New York	5.9%	0.6%	6.2%	0.5%
All Canada Border States (2)	25.9%	21.9%	25%	21.5%
Louisiana	10.3%	12.3%	10.7%	13.4%
New Jersey	9.6%	7%	10.1%	7.5%
Tennessee	0.6%	13.1%	0.3%	14.5%

1. Includes Arizona, California, New Mexico and Texas;
2. Includes Idaho, New Hampshire, Maine, Michigan, Minnesota, Montana, New York, New Hampshire, North Dakota, Ohio, Pennsylvania, Vermont and Washington.

Source: U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1993 Data), August 1995 and U.S. EPA, National Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 1991 Data), April 1994.

Table 9. Exports from the U.S. to Canada, Mexico and the Rest of the World, 1993

Country of Import	Management Method or Type of Waste	Quantity in Tons
CANADA	Reclaimed/Recycled, including Fuel blending	16,770.72
	Incineration	13,936
	Treatment and Landfilled	39,591
	Total	70,297.72
Mexico	Metal Reclamation (emission control dust from electric arc furnace steel mills)	71,596.78
Other Countries	Metal Reclamation	813.95
Totals		142,708.95

Source: Information provided to authors by U.S. EPA from Exports Database

Table 10. Number of Waste Streams and Waste Notices of Exports, 1990-93

Country	1990	1991	1992	1993
Canada-Notices	503	467	499	489
Canada-Waste Streams	1060	848	1061	1042
Mexico-Notices	20	17	7	15
Mexico – Waste Streams	20	17	7	15
Totals -- Notices	574	544	529	526
Totals-Waste Streams	1141	976	1098	1085

Note: Total includes exports of waste to Europe and other OECD countries.
Source: Information provided by U.S. EPA, 2000 from IMPORTS and EXPORTS databases.

Table 11. Tons of RCRA hazardous waste and Number of RCRA Hazardous Waste Manifests received from Mexico, 1991-1993

Category	1991	1992	1993

Tons of RCRA Hazardous Waste	5524	6833	9437
Number of Manifests	874	1201	2208

Source: U.S. EPA, HAZTRAKS Database, 1998.

Table 12: Requirements of Hazardous Waste Generators in Mexico, 1988-1993

A. Characterize whether or not wastes are hazardous;
B. Register with SEMARNAP as a hazardous waste generator;
C. Prepare, if necessary, Accident Prevention Program and Risk Assessment Plans
D. Label and identify hazardous wastes properly
E. Provide proper containment of hazardous wastes for either on-site storage or transport
F. Meet treatment and disposal standards through operating permit
G. Report monthly any entrance or exit of hazardous wastes from facility
H. Complete a manifest for any hazardous waste shipped within Mexico
I. Complete and receive an authorization, known as a "Guia Ecologica" (Ecological Guide) for any export and/or import of hazardous wastes.
J. Report every six months, a summary of the total waste generated, as well as wastes sent off-site:
K. Report to INE if final disposal facility does not send a copy of the manifest back to the generator.

Source: LGEEPA and PROFEPA, 1999 Indice de Cumplimiento de la Normatividad Ambiental en Mexico, Chapter III.

Table 13. NOMs (Normas Oficiales Mexicanas or Official Mexican Standards) Related to Hazardous Waste Generation and Management

NOM-052-ECOL-1993	Establishes hazardous waste characteristics, lists the different waste streams and indicates the limits that make a hazardous residue toxic to the environment
NOM-053-ECOL-1993	Determines the procedures to carry out different extraction techniques to determine waste toxicity.
NOM-054-ECOL-1993	Procedures to determine incompatibility between two or more residues considered hazardous under NOM-052.
NOM-055-ECOL-1993	Requirements for a hazardous waste landfill site, except radioactive waste landfills.
NOM-056-ECOL-1993	Design and construction requirements for complementary works to a hazardous waste landfill site.
NOM-057-ECOL-1993	Design, construction and operation requirements for hazardous waste landfill cells.
NOM-058-ECOL-1993	Requirements for operation of a hazardous waste site.

Table 14. 1988 and 1993 Requirements under Mexican Law for Hazardous Waste Management Facilities

- Submission and approval of either an Environmental Impact Assessment or "preventative report," approved by the INE;
- Operating Permit and/or authorization from SEMARNAP
- Have a laboratory on-site to verify and analyze wastes received
- Training Program
- Safety Commission
- Contingency Plan

- Authorized transport
- Storage requirements
- Keep facility logs of all hazardous wastes moving on or off site;
- Submit six-month report on movement of hazardous wastes in and out of facility to SEMARNAP;
- Monthly report on total waste stored and/or deposited
- Treatment standards (Concentration-based, not method-based)
- Disposal standards

Source: LGEEPA and PROFEPA, 1999 Indice de Cumplimiento de la Normatividad Ambiental en Mexico, Chapter III.

Table 15. Number of regular and quick inspections of manufacturing facilities by PROFEPA in Mexico, 1992 –1994

Year	Complete Inspections	"Quick" Inspections	Total Inspections
1992	4,082	373	4,455
1993	8,699	7,054	15,753
1994	9,514	3,383	12,902

Source: PROFEPA, Triannual Report, 95-97, Figure 1.

Table 16. Rates of compliance with all environmental regulations, August 1992 – December 1994

Year	% Complying	% with Minor Violations	% with Major Violations
1992	17.3	56.4	26.3
1993	19.4	74.0	7.2
1994	20.6	75.7	4.1

Source: PROFEPA, Informe Trianual, 95-97, Figure 3.

Table 17. Number of Environmental Audits Conducted and Action Plan Agreements, 1992-1994

Year	Number of Audits	Number of Action Plan Agreements	Examples of Companies
State-Owned Companies	54	7	PEMEX, Mexican National Railroad System
Private Companies	192	92	CEMEX, General Motors, Cementos Apasco
Totals	246	99	

Source: PROFEPA 1998: Chapter II, Table I.

Table 18. Petitions Received by State Offices of PROFEPA, 1992-1994

Office	Petitions	Percentage
Baja California	829	10%

Jalisco	752	9.1%
Chiapas	731	8.8%
Mexico	493	6.0%
Coahuila	421	5.1%
Puebla	415	5.0%
Chihuahua	403	4.9%
Total	8,267	100%

Source: PROFEPA 1998: Chapter IV.

Table 19. Number of Facilities Authorized to Transport, Collect or Manage Hazardous Wastes in Mexico, 1994

Type of Management Method	Number of Facility
Solvent Recycling	17
Used Oil/Lubricant Recycling	9
Storage Facilities	6
Off-site hazardous waste landfills	2
On-site hazardous waste landfills	2
On-site Incinerators	3
Metal Recyclers	5
On-site Treatment Facilities	22
Fuel Burning Facilities	3
Cement Plants Burning Hazardous Wastes	3
Metal Container Recycling	2
PCB Treatment	1
Soil Remediation Companies	4
Total On and Off-site Hazardous Waste Facilities	79
Transport and Collection Facilities	71

Source: INE, **Programa para la Minimización y el Manejo Integral de los Residuos Industriales Peligrosos en México. 1996-2000, Chapter III-1.**

Table 20. Estimated Generation of Hazardous Wastes in the Mexican Border States, 1994

State	Total Hazardous Waste Generated (miles de ton/año)	Percentage
Baja California	160	2.00
Coahuila	300	3.75
Chihuahua	210	2.62
Nuevo León	800	10.00
Sonora	145	1.81
Tamaulipas	150	1.87
All Border States	1,765,000	22.05
All Mexico	8000	100.00

Note: These totals were based upon number of industries, type of industries and production.

Source: INE/SEMARNAP. Programa para la Minimización y el Manejo Integral de los Residuos Industriales Peligrosos en México. 1996-2000

Table 21: Total Hazardous and Liquid Industrial Waste Generation in Ontario 1986-1991

Year	Reported Waste Generated
1986	3,326,106
1987	4,734,119
1988	5,463,724
1989	5,589,018
1990	4,222,757
1991	4,817,844

Table 22: Ontario Manifested Hazardous and Liquid Industrial Waste Quantities

1990	1,579,978
1991	1,516,271
1992	1,478,087
1993	1,476,661
1994	1,447,448
1995	1,646,382
1996	1,800,000
1997	2,125,000
1998	1,816,585

Table 23: Total Waste Imports and Exports to and From Canada 1987-1998

Year	Imports	Exports
1987	129,476	43,203
1988	144,613	66,304
1989	154,304	103,707
1990	143,411	136,752
1991	135,161	233,079
1992	123,998	174,682
1993	173,416	229,648
1994	342,165	166,234
1995	383,134	225,989
1996	466,614	197,891
1997	487,351	251,302
1998	540,000	276,000
1999	663,000	N/A