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Introduction

Thurston County Environmental Health (TCEH), a division of the Public Health and Social Services Department, conducted a technical assistance campaign for the dental industry. The campaign was funded by solid waste tipping fees and a grant from the Washington State Department of Ecology.

Dentists were identified as good candidates for technical assistance due to recently updated waste disposal regulations as well as the variety of potentially hazardous wastes that are generated by dental facilities. Wastes such as silver-containing x-ray chemicals, scrap mercury amalgam, chair-side sink traps, and vacuum pump filters all contain heavy metals that must be managed properly. Heavy metals are toxic to humans and do not readily break down in the environment. Additionally, past technical assistance efforts for other medical industry sectors identified significant rates of noncompliance regarding the management of spent x-ray chemicals. Specifically, those facilities utilizing onsite silver recovery systems for the treatment of spent fixer solutions were found to have higher rates of noncompliance due to inadequate system maintenance.

In August 2005, the Washington State Department of Ecology (Ecology) enacted new regulations requiring dental facilities to properly manage heavy metal wastes by installing specific types of equipment. These new regulations were part of a Memorandum of Understanding (MOU) with the Washington State Dental Association (WSDA) and Ecology **(Appendix A).** The MOU detailed a variety of Best Management Practices (BMPs) related to proper waste management procedures, all of which were mandated on August 1st, 2005. With generous assistance from Ecology, TCEH designed the technical assistance effort largely based on these new state-wide requirements.

In the summer of 2005, TCEH identified all dental-related facilities in the county. Once the list of potential businesses was completed, TCEH contacted each business with an offer of free technical assistance. The technical assistance effort took place during the fall of 2005 through the spring of 2006. The focus of the campaign was to educate business owners about the new Ecology regulations, ensure compliance with Article VI of the Thurston County Sanitary Code (also known as the Nonpoint Source Pollution Ordinance, **Appendix B**), reduce hazardous waste generation, and to improve overall waste management practices.

The Nonpoint Source Pollution Ordinance is based on the framework of the Washington State Dangerous Waste Regulations. This regulation is found in Chapter 173-303, Section –090 of the Washington Administrative Code. This section of the state regulation characterizes dangerous wastes (hazardous materials) as those solid wastes that exhibit any of the following characteristics.

a. Ignitability: a fire hazard. Generally, a material with a flash point less than 60°C (140°F).

b. Corrosivity: a solid or liquid with a pH of less than or equal to 2.0 or greater than or equal to 12.5.
c. Reactivity: a material that reacts violently with water, generates toxic gases when mixed with water, is capable of detonation or explosive reaction if heated under confinement, or is capable of detonation or explosive reaction at standard temperature and pressure.
d. Toxicity: a material that causes local or systemic detrimental effects in an organism, including asphyxiation, irritation, allergic sensitization, systemic poisoning, mutagenesis, teratogenesis, and/or carcinogenesis.

The businesses included in this campaign are classified as Small Quantity Generators (SQG) of hazardous wastes. Small Quantity Generators (as defined in WAC 173-303-070) may not generate more than 220 pounds of hazardous waste per month or batch, and may not accumulate or store more than 2,200 pounds at any time. Thurston County regulates only those businesses with SQG status, while the Washington State Department of Ecology regulates businesses with Medium Quantity Generator (MQG) and Large Quantity Generator (LQG) status.

Goals

The Business Technical Assistance and Education Campaign is an element of the Thurston County Business Pollution Prevention Program. Success of the technical assistance and compliance elements of the Business Pollution Prevention Program are measured by goals established in the 1998 Hazardous Waste Plan for Thurston County. The goals are:

1. Protect ground water, surface water, soils, sediments, and private property from hazardous materials and hazardous waste contamination.
2. Increase the rate of waste reduction, which conserves resources and reduces demand for disposal and recycling services.
3. Increase the percentage of hazardous waste collected (that cannot be prevented through waste reduction in the first place).
4. Reduce the amount of hazardous materials that is improperly stored, improperly disposed, and accidentally spilled into the environment.
5. Reduce damage to collection and transfer vehicles, and disposal equipment, and reduce disruption of treatment facilities by ensuring hazardous waste is kept out of these facilities or systems.
6. Reduce potential for causing publicly owned facilities such as landfills or sewage treatment plants to exceed pollutant discharge limits.

Methodology

On August 1st, 2003, Ecology and WSDA entered into a MOU regarding the proper management of dental waste. The purpose of the MOU was to reduce the amount of

heavy metal waste being discharged into local municipal sewer systems and onsite septic systems. The MOU addressed the effective management and disposal of mercury in order to ensure compliance with existing waste regulations and to protect the environment. Through mutual discussions, WSDA and Ecology determined common objectives that would be most likely to be achieved by implementing the following BMPs:

1) Install, use, and maintain International Standards Organization (ISO) certified amalgam separators.
2) Collect all amalgam waste and dispose separately. No mercury or other dangerous wastes are to be disposed with solid waste or infectious "red bag" wastes.
3) Properly manage and dispose of all other dangerous waste streams (e.g. x-ray waste, lead foil/aprons).
4) Properly dispose of all scrap amalgam waste from traps, filters, and separators using a licensed treatment, storage, disposal, or recycling facility.
5) Keep amalgam out of sinks and never rinse amalgam waste down the drain.
6) Clean or replace chair-side traps on a regular schedule and properly dispose of amalgam waste.
7) Clean vacuum pump filters regularly, according to the manufacturers recommendations.
8) Maintain all disposal records on site for three (3) years.

Under the terms of the MOU, dentists were given a two year voluntary compliance period regarding the above BMPs. During that time, Ecology developed a reporting system and sent surveys to dental facilities in order to establish a baseline level of BMP implementation. At the end of the voluntary compliance period (August 1, 2005) all dental facilities would be held accountable by Ecology to implement the BMPs.

In order to give the dental community ample time to implement the required BMPs, TCEH began planning the technical assistance effort after the voluntary compliance period expired. While working closely with Ecology staff, TCEH obtained valuable information regarding the compliance status of local dental facilities.

In addition to the recent regulatory changes enacted by Ecology, dentists were identified as good candidates for technical assistance due to the variety of potentially hazardous wastes that are generated as a result of daily operations, primarily mercury and silver. As mentioned above, mercury and silver are toxic, persistent heavy metals that do not readily degrade in the environment. This lack of degradation can also potentially cause heavy metals to accumulate to high levels in the environment as well as the human body. As a result, the Lacey, Olympia, Tumwater, Thurston (LOTT) Wastewater Alliance, Olympia's wastewater treatment facility, limits mercury discharges to 0.05 parts per million (ppm) and silver discharges to 0.2 ppm in wastewaters. Similarly, heavy metal waste must never be disposed into onsite septic systems.

Data collected from past technical assistance efforts by Ecology and TCEH further confirmed the need for additional technical assistance for the medical industry. TCEH found that medical industry sectors had significant rates of noncompliance regarding the

management of spent x-ray chemicals. Specifically, those facilities utilizing on-site silver recovery systems for the treatment of spent fixer solutions were found to have higher rates of noncompliance due to inadequate system maintenance. Additionally, Ecology learned that some dental facilities frequently dispose of scrap amalgam by mixing with regular trash or biohazardous waste. These wastes are commonly disposed in a landfill or incinerator, which has the potential to release mercury into the air or groundwater. Thus, scrap mercury must be managed separately and disposed using the appropriate technology.

The campaign began by assembling a list of all dental facilities based on information gathered from Washington State Department of Health – Radiation Protection Division, Thurston County Public Health and Social Services, as well as local telephone directories. Utilizing these resources, TCEH identified 99 initial sites for technical assistance.

Beginning in September 2004, an invitation letter (**Appendix C**) was sent to the businesses selected for the campaign. The letter announced the upcoming campaign and explained the details of the technical assistance visits and compliance audits. A brief history of the Ecology MOU and the Business Pollution Prevention Program was also included. Businesses were then contacted approximately one week later to schedule a site visit. Site visits were conducted during the fall of 2005 through the spring of 2006.

For participating businesses, a commercial parcel inventory form **(Appendix D)** was used to collect information about a business' source of drinking water, volume of chemical products on site, solid waste and wastewater disposal, floor drains, historical land use, hazardous waste generation, and spill/emergency response preparedness. The form contained questions regarding mercury waste management, silver recovery equipment, as well as other industry-specific topics.

An on-site assessment of hazardous waste management was performed as a component of the technical assistance visit. The assessment looked at hazardous materials used by each business and verified compliance with Ecology and Thurston County regulations. County staff also utilized the opportunity to suggest other voluntary BMPs. BMPs are non-regulated practices designed to reduce generation of hazardous waste, use less-toxic products, recycle, and make improvements in housekeeping and hazardous waste management. Each business received an educational computer CD-ROM **(Appendix E)** that contained updated state and county regulatory information as well as other recommended BMPs.

The CD-ROM format was chosen over paper copies due to the large volume of material presented. In order to view the CD-ROM quickly and conveniently, the information was organized by subject matter and utilized a descriptive table of contents, which had direct links to the material by simply clicking on the title. This format allowed the material to be stored on multiple computers, but could also be printed for training manuals, safety meetings, etc.

After the technical assistance visit took place, the business representative was notified as to whether their business was in compliance with the Ecology regulations and the Thurston County Sanitary Code. Businesses meeting these requirements were issued a Notice of Compliance **(Appendix F)**. Businesses that were not in compliance were issued a Notice of Non-Compliance **(Appendix G)** and given a mutually agreed upon time frame in which to correct the problem(s). If the problem(s) was corrected, a Notice of Compliance was issued during a follow-up visit.

A customer survey (**Appendix H**) along with a self-addressed stamped envelope was also given to each business participating in the campaign. The survey asked businesses to describe any changes they had made in their hazardous waste management practices as a result of the campaign. It also asked businesses how they find out about hazardous waste management, how useful they found the campaign, and their impressions on the quality of service provided by Thurston County's Business Pollution Prevention Program.

Follow-up calls or site visits were conducted several weeks after the initial visit to evaluate the implementation of voluntary BMPs. Since BMPs are not considered compliance issues, businesses were given educational information and recommendations. The list of recommended BMPs is located in **Appendix I.**

Results

A total of 99 sites were initially identified for technical assistance. Of the original 99 sites, 72 received technical assistance visits. Twenty-seven (27) of the 99 initial sites were not visited for the following reasons:

1) Fifteen (15) did not generate hazardous waste (i.e. used digital x-ray, no amalgam used, orthodontics only, etc).
2) Eight (8) could not be located or did not respond to attempted contacts.
3) Two (2) were in the process of closing or relocating.
4) Two (2) sites were already visited by Ecology.

Of the 72 businesses receiving site visits, 22 (31%) were already in compliance with state and county regulations at the time of the initial visit, while 50 (69%) were not. At the end of the campaign, 70 businesses were in compliance, while two (2) were pending compliance. An additional 50 follow-up visits were completed for those not in compliance, resulting in 122 total site visits. Compliance summaries are listed below in **Table 1**. The specific issues resulting in noncompliance are listed in **Table 2**.

Table 1: Compliance Results

Compliance Status	At the Time of the Initial Visit	At the End of Campaign
In compliance	22	70
Out of compliance	50	0
Pending compliance	N/A	2

Table 2: Compliance Issues

Compliance Issue	At the Time of the Initial Visit	At the End of Campaign
No secondary containment	14	0
No amalgam separator	4	1
Inadequate silver treatment system	33	2
Improper disposal into sewer system	2	0
Improper disposal into septic system	6	0
Improper lead disposal	4	0
Improper amalgam disposal (biohazard)	19	1
Improper amalgam disposal (trash)	11	0
Inadequate waste disposal documentation	42	0
Total Issues	**135**	**4**

Current Trends in the Dental Profession

As mentioned above, various information was collected about individual businesses utilizing the commercial parcel inventory form. After the initial inspections were completed, several trends were identified regarding wastewater treatment and hazardous waste disposal. These trends are listed below in **Table 3, Table 4, and Table 5.**

Table 3: General Dental Facility Trends

Sites utilizing public sewer system for wastewater disposal (LOTT)	65
Sites utilizing septic systems for wastewater disposal	7
Sites not using mercury amalgam (composite only)	16
Sites planning to decrease the use of amalgam in the future	37

Table 4: Amalgam Management/Disposal Trends

Sites using vendor pick-up services for amalgam disposal	31
Sites using drop-off/mail away waste disposal services	14
Sites using vendor for amalgam separator maintenance	55
Sites accumulating amalgam onsite (no current disposal vendor)	13

Table 5: X-ray Waste Management Trends

Sites using vendor pick-up services for waste disposal	15
Sites using local drop-off waste disposal services	18
Sites using silver recovery systems	34
Sites using vendor for silver recovery system maintenance	22
Sites upgrading inadequate silver recovery systems to meet current regulations	18
Sites removing inadequate silver recovery systems for proper off-site vendor disposal	14

Disposal Options for Spent X-ray Fixer

Spent x-ray fixer contains approximately 3000-5000 ppm silver. Since silver is a toxic, persistent heavy metal, it must be managed properly in order to protect human health and the environment. Managing silver-bearing waste is unique because, unlike most hazardous waste, silver is also a valuable commodity. As a result, there are several waste disposal options and technologies that allow a business to recycle the silver, rendering the remaining liquid non-hazardous:

1) **Onsite Silver Treatment:** For businesses generating larger quantities of silver waste, installing a silver recovery system may be a good option. These systems remove silver from solutions utilizing chemical recovery cartridges (CRCs) and produce a non-hazardous liquid that can be discharged to a municipal sewer system. A refining company may then process the spent CRCs and recover the raw silver. However, due to startup costs, refining fees, and required maintenance, these systems may not be economical for businesses producing small quantities of silver-bearing waste.
2) **Waste Pick-up Services:** Businesses also have the option of utilizing a waste disposal pick-up service. There are several local companies that transport waste offsite for silver refining. This method does not require expensive equipment or maintenance and eliminates the potential for equipment failure, which can result in wastewater discharge violations. However, ample storage space is required for waste containers, as well as adequate secondary containment for spill prevention. Additionally, since some hazardous waste vendors specialize in larger shipments, it may not be economically feasible to transport small quantities.
3) **Using Another Local Business for Disposal:** Since silver recovery systems are also utilized by commercial photo developers and many other medical facilities, a business may accept silver waste from other businesses for proper treatment. This is a good option for those who generate a small quantity of waste.

Free Local Silver Recycling

Don's Camera, a commercial photo processor in downtown Olympia, utilized a silver recovery system for treatment of their processing wastes. For many years, Don's Camera extended their treatment capabilities and offered free waste disposal services to approximately 15 dental facilities and numerous other medical offices. Unfortunately, Don's Camera stopped this service in January of 2006. At that time, the only other free disposal site was at The Evergreen State College (Evergreen). In 2004, the Evergreen Photography Department began offering free silver treatment services, which was facilitated by TCEH during another technical assistance campaign for medical offices. Evergreen still gladly offers this service, however, their distant location makes this option inconvenient for some dental facilities.

After conducting numerous site visits, it was apparent that most dental facilities produced approximately 1-2 gallons of silver-containing x-ray waste per month. Due to the small quantity of waste, silver recovery systems and waste pick-up services were found to be potentially costly and/or inconvenient for many dental facilities. As noted above, it was also observed that 34 (47%) dental facilities were utilizing improper silver recovery systems. Due to the unusually high rate of non-compliance, TCEH began researching alternative disposal methods. Based on past technical assistance efforts, TCEH discovered that approximately 30-40 local businesses have utilized Don's Camera, with the potential for many additional customers.

In March of 2006, TCEH decided to research new disposal options for x-ray fixer. While conducting past technical assistance efforts, county staff discovered that the majority of commercial silver recovery systems used by local businesses are sold by Hallmark Refining, Inc (Hallmark). Hallmark installs and maintains silver recovery systems for virtually all types of applications, large or small. Since the company is located in Western Washington, they frequently visit the Olympia area and are readily available for service requests. In March 2006, Hallmark installed a new silver recovery system at the Thurston County Moderate Risk Waste Facility (HazoHouse) located in Lacey, Washington. HazoHouse began accepting used x-ray fixer free of charge from all Small Quantity Generators (SQGs) per Ecology regulations. Within two months after installing the system, HazoHouse received approximately 100 gallons of used fixer from local dentists. Conservatively, it is estimated that HazoHouse will receive approximately 600 gallons of used fixer per year, which will result in the recycling of approximately 20 pounds of silver.

Due to the estimated demand for free silver recycling services, the LOTT Alliance installed a similar Hallmark recovery system at the Budd Inlet wastewater treatment plant in downtown Olympia. This new service offers a convenient drop-off location for businesses located in the Olympia-Tumwater areas, while the HazoHouse drop-off location benefits the Lacey-Yelm areas **(See Appendix J).**

Best Management Practices

In addition to regulatory requirements, other recommended BMPs are also presented during technical assistance visits. The goal is to encourage businesses to improve all aspects of hazardous material management, from chemical purchasing to final waste disposal.

Table 6: Best Management Practices

Best Management Practice (BMP)	Number of Times Suggested	Number of Times Implemented
Use capsulated amalgam alloy	0	0
Purchase appropriate amount of products	0	0
Store products so they don't become a waste	0	0
Recycle scrap amalgam	18	16
Salvage scrap amalgam from restorations	31	27
Recycle waste x-ray film	31	15

Recycle lead foil and aprons	13	12
Recycle fluorescent lamps	21	7
Install ISO 11143 approved amalgam separator	3	3
Collect vacuum pump waste and properly dispose	21	10
Use chair-side traps to collect scrap amalgam	4	4
Avoid mixing amalgam and biohazard waste	34	28
Test silver recovery system frequently (silver, pH)	10	9
Replace silver cartridges at appropriate intervals	9	9
Remove excess accumulation of waste(s)	14	12
Keep disposal receipts and/or log book	42	32
Use less toxic system cleaners	0	0
Label unmarked containers/drums	6	6
Keep/update Material Safety Data Sheets (MSDS)	1	1
Obtain appropriate spill supplies	28	20
Implement spill plan	32	20
Provide adequate secondary containment	17	15
Seal floor drains	2	2
Secure shelving	6	4
Implement hazardous materials training for staff	1	1
Total BMPs	**344**	**253**

Customer Survey

Forty-eight (48) of the 72 (66%) businesses that received a customer survey during the initial site visit completed and returned the form. A summary of the customer survey form is listed below in **Table 7**.

Table 7: Customer Survey Responses

Survey Question	Yes	No	Unsure	No change needed
1a. Was your business in compliance following the initial visit?	19	26	3	

	Yes	No	Unsure	No change needed
1b. If not, were you in compliance by the end of the campaign?	28	0	1	

	Yes	No	Unsure	No change needed
2. Did the visit assist you in making changes in the way you manage your hazardous materials/wastes?	45	1	0	3

	Disposal costs	Equipment costs	Where to obtain disposal information?	Understanding regulations	Extra time required for proper management and disposal	Safety and liability issues
3. What concerns you most about proper hazardous waste management?	12	5	14	27	8	14

4. Where do you obtain information regarding hazardous materials management? Comments: *Govt. Agencies (28), Dental Assn. (12), Vendor (7), Online (2), Training Classes (2), Material Safety Data Sheets (1), Corporate Office (1), Word of Mouth (1)*

	Yes	No	Unsure	No change needed
5a. Did you have any specific questions during the visit?	20	26	0	
Please describe: *Waste Disposal (14), Disposal Vendors (2), Safety Supplies (2), Other (2).*				

	Yes	No	Unsure	No change needed
5b. If so, did the county specialist	28	0	1	

provide specific answers that addressed your question?				

	Yes	No	Unsure	No change needed
6. Was the specialist knowledgeable?	49	0	0	

	Yes	No	Unsure	No change needed
7a. Do you plan to use the "Dental Waste Resource Guide" CD for current or future reference?	42	3	4	
7b. Which format do you prefer? *Computer CD: 26* *Paper copy: 23*	N/A	N/A	4	

	Yes	No	Unsure	No change needed
8. Overall, did your business benefit from the technical assistance program? Comments:	55	2	0	

	Yes	No	Unsure	No change needed
9. In addition to the technical assistance program, TCEH provides businesses with an information line, newsletter, disposal site, and a website. Do you currently use or will you use these services?	N/A	N/A	N/A	
Which services? *Hazardous Waste Hotline: 11* *Business Newsletter: 10* *HazoHouse: 36* *Website: 22*				

	Yes	No	Unsure	No change needed

10. Are there additional services TCEH can provide?	3	24	21	

	Yes	No	Unsure	No change needed
11. Thurston Co. has considered purchasing a silver recovery system in order to provide free drop-off service for fixer disposal. If offered, would you use this service?	38	11		
If yes, which drop-off location would you prefer?	1. *LOTT Wastewater Alliance: 17* 2. *Thurston Co. HazoHouse: 21*			

12. Additional Comments?	*Thank You (5), Very Helpful (2), Very Informative (2), Very Pleasant Meeting (2), Good Information (1), Very Professional (1), Knowledgeable Specialist (1), Love the CD (1), Dons Camera does a good job (1), Transporting fixer is difficult (1).*

Meeting the Goals of the Hazardous Waste Plan for Thurston County

Success of the technical assistance and compliance elements of the Business Pollution Prevention Program are measured by goals established in the 1998 Hazardous Waste Plan for Thurston County. The outcomes for each goal are listed below:

Protect ground water, surface water, soils, sediments, and private property from hazardous materials and hazardous waste contamination:

- √ Fifty (50) businesses achieved compliance with the Thurston County Nonpoint Source Pollution Ordinance, which mandates proper storage and disposal of hazardous materials.
- √ Thurston County verified that 22 businesses were already conducting proper management and disposal of hazardous materials.
- √ Thirty (30) businesses stopped improperly disposing of mercury amalgam waste.

- √ Fourteen (14) businesses improved their chemical storage practices by installing adequate secondary containment. This included the installation of spill containment pads and/or sealing floor drains to prevent hazardous material discharges into the environment.
- √ Eight (8) businesses stopped discharging spent x-ray chemicals into on-site septic systems or the LOTT sewer system.
- √ Thirty-two (32) businesses updated and improved their waste disposal recordkeeping practices, which ensures proper handling of all types of hazardous materials and waste.

Increase the rate of waste reduction, which conserves resources and reduces demand for disposal and recycling services:

- √ Thurston County HazoHouse and the LOTT Alliance created new local drop-off services for silver waste recycling, which eliminates the need for long-distance transportation to out-of-state disposal facilities.
- √ Eighteen (18) businesses upgraded to proper on-site chemical treatment systems, which recycle silver and eliminates the need for off-site transportation and disposal of spent photographic fixer.
- √ The campaign verified that 38 businesses utilize vendors that monitor and manage chemical inventories, which help prevent shelf life expiration resulting from overstock situations.
- √ The campaign verified that every business utilized at least one type of less toxic chemical alternative, which commonly included low-toxicity disinfection products.
- √ Sixteen (16) businesses no longer utilize mercury amalgam and 37 others plan to decrease amalgam use.
- √ Fifteen (15) businesses utilize digital x-ray, which produces no chemical waste.

Increase the percentage of hazardous waste collected (that cannot be prevented through waste reduction in the first place):

- √ As a result of the campaign, two new silver waste recycling services were created by Thurston County HazoHouse and the LOTT Alliance. It is estimated that these services will collect and treat approximately 600 gallons of spent x-ray fixer per year, resulting in over 20 pounds of recycled silver.
- √ Thirty (30) businesses stopped improperly disposing of scrap amalgam and now utilize recycling services.
- √ Fourteen (14) businesses permanently removed inadequate silver treatment systems and now use proper off-site recycling services.
- √ As a result of the campaign, twelve (12) businesses disposed of accumulated waste chemicals.
- √ Four (4) businesses stopped improperly disposing of scrap lead and now utilize recycling services.

- √ Four (4) businesses installed mercury amalgam separators that collect scrap amalgam for future recycling.
- √ Four (4) businesses agreed to recycle spent fluorescent lamps.

Reduce the amount of hazardous materials that is improperly stored, improperly disposed, and accidentally spilled into the environment:

- √ As a result of the campaign, 50 businesses stopped improperly storing and/or disposing of hazardous wastes.
- √ Fourteen (14) businesses added secondary containment to their chemical storage areas.
- √ Thirty-three (33) businesses contained inadequate silver treatment systems, which were all upgraded or removed as a result of the campaign.
- √ Thirty (30) businesses stopped improperly disposing of mercury amalgam waste.
- √ Eight (8) businesses were improperly disposing spent x-ray chemicals into septic or sewer systems. These issues were resolved by utilizing waste disposal vendors or proper treatment systems.
- √ Twenty (20) businesses agreed to implement written emergency spill plans for their facilities.
- √ Twenty (20) businesses updated their emergency spill kits or purchased additional spill supplies.

Reduce damage to collection and transfer vehicles, and disposal equipment, and reduce disruption of treatment facilities by ensuring hazardous waste is kept out of these facilities or systems:

- √ As a result of the campaign, six (6) businesses stopped improperly disposing of spent x-ray chemicals into onsite septic systems.
- √ Two (2) businesses stopped improperly disposing of spent x-ray chemicals into the LOTT municipal sewer system.
- √ Eighteen (18) businesses upgraded to proper on-site chemical treatment systems, which prevents untreated silver waste from entering the LOTT municipal sewer system.
- √ Fourteen (14) businesses permanently removed inadequate silver treatment systems, eliminating the potential for improper sewer discharges.
- √ Four (4) businesses installed mercury amalgam separators that collect scrap amalgam and reduce mercury discharges to wastewater.
- √ Twenty-one (21) businesses agreed to obtain updated Material Safety Data Sheets, which provide proper disposal, handling, and safety information for x-ray chemicals.
- √ Six (6) businesses agreed to properly label waste storage containers, which prevents improper waste handling and disposal.

Reduce potential for causing publicly owned facilities such as the landfill or sewage treatment plants to exceed pollutant discharge limits:

- √ Fifty-five (55) businesses utilize vendors to service amalgam separators, which helps to ensure that the systems are functioning properly, reducing potential mercury discharges to wastewater.
- √ The campaign verified that twenty-two (22) businesses utilize vendors to service their silver recovery systems, which helps ensure that no silver waste enters wastewater treatment systems.
- √ Thirty-three (33) businesses contained inadequate silver treatment systems, which were all upgraded or removed as a result of the campaign.
- √ Eight (8) businesses stopped improperly disposing of spent x-ray chemicals into the municipal sewer or onsite septic systems.
- √ Twenty-one (21) businesses received information regarding proper disposal options for spent fluorescent lamps.
- √ In order to prevent spills from entering the sanitary sewer or onsite septic system, fourteen (14) businesses provided additional secondary containment for chemical storage areas.

Conclusions

This single-industry campaign focused on the dental industry. Most single-industry campaigns focus on business types that represent a potential risk to public health and the environment. This risk is illustrated by improper storage, use, and disposal of hazardous materials. Dentists were identified as good candidates for technical assistance due to the various heavy metal wastes produced. Mercury, silver, and lead are toxic to humans and persistent in the environment. Since heavy metals are not adequately treated by onsite septic or sanitary sewer treatment systems, any waste entering these systems has the potential to impact the environment.

Twenty-two (22) of the 72 businesses (31%) inspected were in compliance with the Thurston County Sanitary Code, while 50 (69%) were not. The most common compliance issues involved improper silver recovery systems and improper scrap amalgam disposal. Thirty-three (33) businesses contained improperly maintained and/or inadequate silver recovery systems. Eight (8) others improperly discharged spent x-ray chemicals into the municipal sewer or septic system. A total of 30 businesses (42%) were improperly disposing of chair-side scrap amalgam.

Compliance rates for amalgam separator installation were very high. Sixty-eight (68) dental facilities (94%) installed the proper amalgam separator prior to the initial site visit. This high rate of compliance appeared to be inconsistent when compared with the much lower rates of compliance for silver and chair-side scrap amalgam disposal. Since 2003, Ecology and the WSDA made numerous contacts to dental facilities statewide, offering

detailed information regarding the new requirements for dental waste management. The information included proper handling procedures for all types of waste as well as local disposal resources and vendors. It is unclear why dental facilities in Thurston County implemented amalgam separator improvements more readily than other best management practices offered by Ecology and the WSDA.

After reviewing the customer surveys, several trends were identified that may offer clues regarding these inconsistent compliance rates. When asked what concerns businesses most about hazardous waste management, 27 of 48 respondents (56%) cited the understanding of regulations, while another 14 respondents (29%) cited knowing where to obtain disposal information. However, when asked where dental facilities obtain disposal information, 28 respondents (58%) cited government resources. Only seven respondents (15%) utilize vendors for waste disposal information, which was surprising since most vendors offer disposal services and provide disposal-related equipment. Since vendors have the most frequent contact with businesses, it is suggested that future technical assistance efforts include or start with waste disposal vendors.

After concluding the campaign, it was evident that the participating businesses improved their waste management practices and clearly benefited as a result of this effort. Forty-eight (48) businesses achieved compliance and a total of 135 separate compliance issues were resolved. In addition, eight (8) businesses stopped discharging untreated wastes into sewer or septic systems and fourteen (14) others added secondary containment to chemical storage areas. Together, the businesses implemented 255 BMPs and were provided with two new silver waste recycling options.