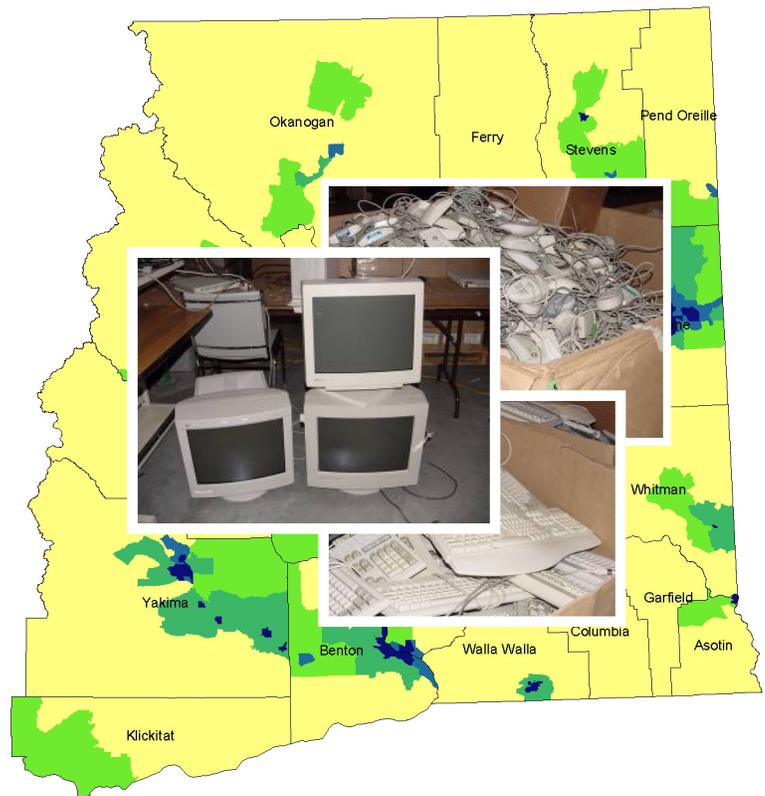


Assessment of Electronic Waste Generation, Collection, and Processing in Eastern Washington

Final Report

December 31, 2002



*Prepared by Cascadia Consulting Group, Inc.
for the Washington State Department of Ecology*

Table of Contents

Executive Summary	i
1. Introduction	1
2. Electronic Waste Generation.....	2
METHODOLOGY	2
COMPUTER OWNERSHIP IN EASTERN WASHINGTON.....	3
TECHNOLOGY TRENDS.....	5
E-WASTE PROJECTIONS	6
3. Current Services and Policies.....	13
4. Assessment of Service Needs and Product Stewardship Opportunities	23
ASSESSMENT OF SERVICE NEEDS	23
AREAS FOR FURTHER RESEARCH	33
CONCLUSIONS.....	34
Works Cited	37
Appendix A: Calculation and Projection Methodology.....	A-1
Appendix B: Additional Product Stewardship Information	B-1
Appendix C: Additional Maps of Electronics Sales Outlets and Facilities	C-1

Executive Summary

The purpose of this report is to assess the current state of electronic-products recovery in Eastern Washington, and to recommend actions to expand it. The availability of recovery options for electronic waste (e-waste) in Washington has recently become increasingly important, as Ecology's "Interim Enforcement Policy for Cathode Ray Tubes" provides exemption from dangerous waste regulations if cathode ray tubes (CRTs) and associated electronic wastes are recycled. The information contained in this report can be used to determine how to maximize e-waste recovery, including the possibility of a product stewardship system, in Eastern Washington.

For the purposes of this project, electronic waste, or e-waste, is defined as computers, associated peripherals, monitors, and televisions that are being discarded now or soon will be. The study area is defined as all of the counties in the Department of Ecology's Central and Eastern regions, collectively referred to as Eastern Washington.

This project had four major tasks:

- **Estimate current and projected e-waste generation and stockpiling** among households and small quantity generators.
- **Research current e-waste services and policies** by surveying recycling coordinators, landfill and transfer station operators, waste haulers, health districts, and selected non-profits, charities, and businesses.
- **Create maps of Eastern Washington to depict present and possible future locations for e-waste collection service**, including landfills and transfer stations, major electronics retailers, existing service providers, and non-profit thrift stores.
- **Assess service level needs and how to meet these needs in the context of regional and national product stewardship initiatives.**

These four tasks were designed to provide answers to seven key questions about electronics-recovery practices and opportunities. These answers are provided below. The body of this report explains the answers and the methodologies used to generate them in detail.

KEY QUESTION #1:

HOW MUCH E-WASTE EXISTS AND IS EXPECTED TO BE GENERATED IN THE FUTURE?

- Currently, electronic wastes comprise less than 1% of disposed municipal solid waste¹ (more specifically, a current Seattle study estimates 0.4% by weight²). In addition, field observations at transfer stations in Yakima and Okanogan Counties, conducted for 3- 5 days in November 2002, found almost no electronic waste.

¹ Franklin Associates. Municipal Solid Waste in the United States: 2000 Facts and Figures: Washington, DC: Environmental Protection Agency Office of Solid Waste and Emergency Response, June 2002.

² Cascadia Consulting Group, 1998/1999 Residential Waste Stream Composition Study: Final Report. Seattle: Seattle Public Utilities, Feb. 2000.

- However, residents in Eastern Washington are currently storing an estimated 530,000 unused televisions, computers, and monitors — a quantity of e-waste that weighs nearly 10,000 tons.
- Furthermore, households in Eastern Washington are projected to generate an additional 390,000 obsolete units *annually* (about 7,400 tons, or 23 lbs per household), a figure that is projected to grow to an estimated 490,000 units annually (8,600 tons, or 24 lbs. per household) in 2010, due in part to the increasing replacement of CRT units with flat-panel displays. These figures represent about 1.0% – 1.2% of current and projected future residential waste disposal.
- The quantities of e-waste *generated* are likely much greater than what are currently *disposed*. Since recycling opportunities are limited in Eastern Washington, it is plausible to infer that most obsolete electronic equipment goes into storage -- possibly in attics, closets, and garages.
- In addition, small quantity generator businesses are expected to generate an additional 60,000 – 70,000 units annually.

KEY QUESTION #2:

WHAT EXISTING FACILITIES HANDLE E-WASTE?

- Several organizations in Eastern Washington handle used computers and electronic equipment for *resale*. These include non-profits such as Goodwill, St. Vincent de Paul, and the Salvation Army, in addition to at least one foundation, Computers-4-Kids, and a small number of private repair and retail shops.
- However, very few organizations handle electronics for *recycling*. Some local governments have provided collection events for e-waste. Benton County, Chelan County, City of Richland, and City of Kennewick have each held one collection event. In addition, Washington State University runs a computer-recycling program, but only for its own campuses.
- Disposal of electronics is still the standard means of handling equipment that is no longer useful, although in many cases equipment is first stored for prolonged periods. Landfills and transfer stations generally accept e-waste for disposal if it is mixed with mainstream waste from households or businesses. However, about half of the landfills and transfer stations surveyed said that they do not take e-waste from small quantity generators.³ The waste-to-energy plant surveyed accepts e-waste.
- Despite Ecology's classification of Cathode Ray Tubes (CRTs) as Dangerous Waste, some disposal facilities still accept them from fully regulated generators.

³ Under Ecology guidelines, a business is considered a small-quantity generator if they generate less than 220 pounds of dangerous waste per month. This translates into 5 – 10 monitors or televisions per month. If a business chooses to recycle its monitors or televisions according to Ecology's Interim Enforcement Policy, then the monitors or televisions are not counted toward those 220 pounds. However, if the business chooses to dispose of the monitors or televisions as hazardous waste, then the monitors or televisions count toward the business's generator status.

KEY QUESTION #3

WHAT NEW SERVICES MAY BE NECESSARY TO COLLECT AND HANDLE THE CURRENT AND PROJECTED E-WASTE ACCORDING TO WASHINGTON STATE LAWS AND POLICIES?

Based upon the survey and other research conducted for this project, the consultant team concludes that a mixture of fixed e-waste collection facilities and collection events may work best to recover the current and future generation of e-waste in Eastern Washington. Although governments could provide these services, the state also could work with retailers and/or manufacturers to provide them through product stewardship programs. It also would be worthwhile to investigate the possibility of building or encouraging the development of a processing facility in Eastern Washington. In the meantime, e-waste should be shipped to domestic processors for disassembly, as overseas processors are less likely to operate in an environmentally sound manner.

A variety of financing mechanisms may be necessary to fund these new services. Through Washington's ongoing participation in the national and regional (NEPSI and WEPSI) processes, the state can continue to lobby for product stewardship programs to finance e-waste recycling, such as fees at the time of purchase or requiring manufacturers or retailers to pay for recycling.

In addition, it may be appropriate to develop state legislation requiring these fees, for use in case an agreement is not reached through the NEPSI process, or to fill the gap between the present and when a national system is adopted. The Northwest Product Stewardship Council has moved toward this goal by adapting⁴ model legislation developed by the Product Stewardship Institute⁵ so that it would be effective in Washington. Ecology likely would find that many local governments would support such product stewardship initiatives: many of the local government representatives contacted for our survey said that they were interested in seeing product stewardship programs develop, particularly those that call for advance disposal fees.

At the same time, Ecology could investigate the feasibility of working with local governments to raise solid waste management fees to cover e-waste services, or charging fees from generators to accept e-waste. The latter program likely is more feasible, given the current political climate, but it would likely be less effective at collecting equipment as the fee could discourage use of the program in favor of storage or illegal dumping.

KEY QUESTION #4

WHAT OPPORTUNITIES MAY EXIST TO DEVELOP PRODUCT STEWARDSHIP INITIATIVES WITH LOCAL BUSINESS, AND TO COLLABORATE WITH OTHER ENTITIES, LOCALLY, REGIONALLY, AND NATIONALLY?

This study revealed a number of opportunities to work with local businesses to provide collection and hauling services that might be part of a product stewardship initiative with retailers or manufacturers.

⁴ Patricia Jatczak, personal communication to Laura Blackmore, January 14, 2003.

⁵ <http://www.productstewardshipinstitute.org/policies.htm>

- Many surveyed landfills, transfer stations, and non-profits said they could serve as collection points for e-waste reuse and recycling.
- Several haulers stated that they currently have the ability to expand their operations to include e-waste.

In themselves these opportunities do not represent a product stewardship program. In order for an e-waste recycling program to be considered a product stewardship initiative, manufacturers or retailers would have to be involved somehow, either through financing the program or serving as collection points. However, the fact that many respondents to our survey were enthusiastic about participating in an e-waste recycling program bodes well for the future establishment of such a program.

The most commonly cited opportunities to collaborate with others were as follows:

- Governments can partner with each other to hold collection events.
- Governments and charities can partner with schools to provide reused computers and perhaps to collect their obsolete equipment. Six local governments mentioned the possibility of partnering with school systems, and the Office of the Superintendent of Public Instruction has published “Minimum Standards for State Surplus Computers Donated to K-12 Schools” to facilitate identification of electronics that schools can use.⁶ However, additional research should be carried out to determine the true extent of the demand in the schools for refurbished electronics. One local government contact warned that a year or two after receiving donated electronics, schools will find that these refurbished electronics no longer meet their needs and will be searching for ways to dispose of them.
- Governments and businesses can work together to establish collection programs. For example, Douglas, Chelan, and Kittitas Counties are working with the Department of Ecology and Total Reclaim (in Seattle) to develop a pilot program to collect e-waste from businesses. The partners hope to make the program viable, expand it to households and eventually transfer the program to the private sector.
- Several local governments also expressed interest in working with local retailers to establish product stewardship programs, although none have done so to date.

However, as a result of funding constraints, the ability of local governments to collaborate with each other, with schools, or with regional and national entities is limited. Some local governments do not have enough funding to add additional services at this time.

KEY QUESTION #5

WHICH LANDFILLS AND INCINERATORS HAVE BEGUN TO ENFORCE THE PROHIBITION OF CRTs GENERATED FROM FULLY REGULATED GENERATORS?

For this study, thirteen landfill and transfer station operators were surveyed. Of these, seven respondents operated landfills. According to our survey, five landfills have begun to enforce the prohibition of CRTs generated by fully regulated generators.

⁶ Patricia Jatczak, personal communication to Laura Blackmore, January 14, 2003. The standards can be viewed online at <http://www.k12.wa.us/edtech/standards.asp>

On the other hand, three landfills reportedly still accept CRTs from fully regulated generators. One landfill said that they would stop accepting waste from fully regulated generators when “the EPA regulations are accepted by the state.”

None of the seven landfills surveyed restrict or plan to restrict disposal of CRTs generated by households. Two of the seven prohibit small quantity generators from disposing CRTs, and one is “looking to change its policy” on small quantity generators.

The Spokane Waste-to-Energy facility was the only incinerator interviewed for this project. According to the respondent, the waste-to-energy facility still accepts e-waste from all generators, including fully regulated generators, if the e-waste is mixed with mainstream waste, and does not plan to stop doing so.

All of the ten local health districts surveyed allow households to dispose CRTs.

KEY QUESTION #6

WHICH JURISDICTIONS AND WASTE MANAGEMENT COMPANIES PROVIDE HAZARDOUS WASTE TECHNICAL ASSISTANCE AND SERVICES TO SMALL QUANTITY GENERATORS, AND WHICH ARE PLANNING ON ADDING E-WASTE TO THEIR SERVICES?

Of the ten waste management companies surveyed, seven said that they provide technical assistance to small quantity generators (SQGs) to help them manage hazardous waste. One hauler provides referrals for SQGs who would like to manage e-waste, but none of the others plan to add e-waste services.

None of the local governments surveyed provide e-waste-specific technical assistance to SQGs. Seven of the twenty-three local governments surveyed plan to add e-waste to their services, and four are hoping to do so.

KEY QUESTION #7

GIVEN THAT NATIONAL-LEVEL PRODUCT STEWARDSHIP INITIATIVES FOR ELECTRONICS CALL FOR “CONVENIENT” COLLECTION OPTIONS, WHAT WOULD BE CONSIDERED “CONVENIENT” IN EASTERN WASHINGTON?

Respondents to the survey overwhelmingly said that “convenient” services would have to be free, and would have to be offered at either “central” or “multiple” locations. Although respondents did not specify exactly where “convenient” locations would be, several options seem logical:

- Offer services at transfer stations and landfills where residents and small quantity generators self-haul wastes. Since these generators already use these facilities, they would likely find it convenient to bring the e-waste there as well.
- Offer services at existing recycling depots. Like the transfer stations and landfills, residents of and businesses in Eastern Washington already use these facilities.
- Add electronics to household hazardous waste collection events.
- Work with retailers to offer collection services on-site, such as drop-boxes or take-back programs.

Although respondents did not specify how close a collection site would need to be for them to consider it convenient, one model for convenience could be the distance that residents are willing to travel to existing transfer stations and landfills or recycling centers. The data from the survey shows that residents commonly travel up to 20 miles to reach existing facilities, with some residents traveling as far as 60 miles.

1. Introduction

According to recent local and national waste composition studies,⁷ electronic equipment comprises less than 1% (by weight) of most municipal solid waste. However, equipment such as TVs, computer monitors, and computer central processing units (CPUs) contain potentially toxic materials. Because of the potential for toxics to escape from landfills into the environment, most waste and environmental officials believe electronic waste deserves more attention and vigilance than its relatively small volume would otherwise require. Furthermore, several recent studies have suggested that large quantities of obsolete electronics are currently stored and stockpiled rather than disposed.⁸ At some point, owners of obsolete electronics will choose to get rid of these items, and the quantities of e-waste requiring effective management will increase.

The Washington State Department of Ecology commissioned this study to examine the rates of electronic waste (e-waste) generation and stockpiling, current e-waste handling policies and practices, and future services that may be required in Eastern Washington. This project had four major tasks:

- Estimate current and projected e-waste generation and stockpiling among households and small quantity generators.
- Research current e-waste services and policies by surveying recycling coordinators, landfill and transfer station operators, waste haulers, health districts, and selected non-profits, charities, and businesses.
- Create maps of Eastern Washington to depict present and possible future locations for e-waste collection service, including landfills and transfer stations, major electronics retailers, existing service providers, and non-profit thrift stores.
- Assess service level needs and how to meet these needs in the context of regional and national product stewardship initiatives.

Chapter 2 of this report presents the estimates of e-waste generation and stockpiling, Chapter 3 reports the results of the survey, and Chapter 4 synthesizes this information and provides recommendations of ways to provide e-waste services, with or without product stewardship programs. Appropriate maps are contained in Chapter 4, but Appendix C provides several additional maps of facilities and electronics retail stores.

⁷ Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: Washington, DC: Environmental Protection Agency Office of Solid Waste and Emergency Response, June 2002 and Cascadia Consulting Group, *1998/1999 Residential Waste Stream Composition Study: Final Report*. Seattle: Seattle Public Utilities, Feb. 2000.

⁸ Massachusetts Department of Environmental Protection. "Electronics re-use and recycling infrastructure development in Massachusetts." September 2000. and California Integrated Waste Management Board. "Selected E-Waste Diversion in California: A Baseline Study." November 2001.

2. Electronic Waste Generation

Several recent city, state, and national-level studies have estimated the quantities of computers and televisions that are likely to become obsolete in the coming years.⁹ Typically, these projections are conducted in order to assess the magnitude of the e-waste problem and to identify when and where new processing infrastructure will be required. In this study, the consultant uses U.S. Census survey information combined with technology and sales projections from other studies to estimate the present and future generation of obsolete electronic equipment in Eastern Washington.

METHODOLOGY

In September of 2001, the U.S. Census Bureau conducted a national Current Population Survey. Among other topics, the survey inquired about respondents' computer purchase and ownership patterns. Although results were not reported for Eastern Washington, the consultant obtained and processed the raw survey data from the Census Bureau in order to understand the following:¹⁰

- What percentage of households in Eastern Washington own computers;
- How many computers, on average, each household owns; and
- When households purchased their newest computer.

These statistics formed the foundation for projections of future e-waste generation from residential households. By obtaining data and projections from other studies on annual sales growth and technology trends, and making simple assumptions about the average useful lifespan of computers, the consultant was able to construct present and future estimates of the quantities of electronic waste generated by residents in Eastern Washington. Similar calculations were conducted for televisions. In addition, estimates of the number of computers currently stockpiled were estimated based on survey information conducted in California, applied to Washington on a per-household basis. These calculations, and assumptions used, are detailed in Appendix A.

Key assumptions made in these calculations include:

- Computer monitors (both CRT and flat-panel) have an average useful life of 4 years;¹¹
- Computer bases, or central processing units (CPUs), have an average useful life of 3 years,¹² and
- Televisions have an average useful life of 8 years.¹³

⁹ Including Carnegie Mellon's pioneering 1997 *Disposition and End-of-Life for Personal Computers*, Massachusetts' 2000 *Electronics re-use and recycling infrastructure development in Massachusetts*, and California's 2001 *Selected E-Waste Diversion in California: A Baseline Study*

¹⁰ See Appendix A for further discussion of this survey data and the process used to interpret it.

¹¹ The National Safety Council estimated initial monitor lifespan to be 4 years (plus up to 2-3 years if re-used), but did not differentiate CRT vs. flat-panel life. The EPA, in their life-cycle comparison of flat-panel and CRT monitors, assumed they would have essentially the same useful lifespans.

¹² The National Safety Council estimates that the current useful life of CPUs is about 3 years. In the past this was higher, and is expected to decline to about 2 years by the middle of this decade. For this study, 3 years is assumed as an average, and likely conservative, estimate.

In addition to the residential sector, simple projections were also made to estimate future generation of computer waste from small quantity generators (SQGs). These projections rely on current and future employment by industry group, average ratio of employees to computers by industry group, and average useful lifespan of equipment.

The task of defining what types of businesses should be considered SQGs involved making simplified assumptions about which industry groups are SQGs and which are fully regulated generators. Although there are many different types of business in each industry group (and therefore hazardous waste generation varies), the consultant made the simple assumption that the following industry groups were likely to be fully regulated: manufacturing, because of chemicals generated; health care, because of medical waste; and educational institutions, because of the large number of computers they likely generate. All other business types are assumed to be small quantity generators, and included in the projections. These include:

- Wholesale and retail trades
- Real estate, rental & leasing
- Accommodations (hotels and lodging)
- Administrative & support services
- Professional, scientific, & technical services
- Food service
- Arts, entertainment, and recreation
- Agriculture
- Other services (except public administration)

Although this assumption is clearly limiting, the task of categorizing individual businesses was beyond the scope of this study.

COMPUTER OWNERSHIP IN EASTERN WASHINGTON

As discussed above, the consultant obtained raw survey data from the Census Bureau's 2001 Current Population Survey Supplement. Analysis of this data informed the following findings:

- **Computer ownership by households in Eastern Washington is very similar to that in Western Washington, and greater than the national average.**
- **Households in Spokane are more likely to have computers than households in the remainder of Eastern Washington.**
- **Most households have only one computer, but households in Spokane purchased it less recently than their counterparts in the remainder of Eastern Washington.**

Unfortunately, no further geographic comparisons can be made, as Spokane was the only metropolitan statistical area (MSA) identified by the Census Bureau in the Current Population Survey's raw data. Other metropolitan statistical areas in Eastern Washington (including the Yakima and the Tri-Cities areas) may show similar trends, but in this study they are included in the "remainder of Eastern Washington" category because of the limitations in the raw data.

The following table shows detailed analysis of the survey data. Note that 66% of Eastern Washington households owned a computer in 2001, compared to 67% in all of Washington and 57% nationwide.

¹³ Assumption used by the White House Office of Management and Budget

Table 1: Computer Ownership Rates in Eastern Washington

Have computer?	Eastern Washington Households (2001)			National Average (2001)			WA State (2001)
	Spokane	Remainder of E. WA	All E. WA	Urban	Rural	All	All
Yes	80%	59%	66%	57%	56%	57%	67%
No	20%	41%	34%	43%	44%	44%	33%
	100%	100%	100%	100%	100%	100%	100%

Note: Individual figures may not add to total due to rounding.

Of the 66% that have computers, most (79%) own just one. Interestingly, more households in the Spokane area have only one computer than in the rest of Eastern Washington. The following table illustrates what percentage of households own one, two, or at least three computers.

Table 2: Number of Computers Owned, of Households that Own at Least One

# of computers	Eastern Washington Households (2001)		
	Spokane	Remainder of E. WA	All E. WA
1	82%	77%	79%
2	13%	19%	17%
3+	5%	4%	5%
	100%	100%	100%

Note: Individual figures may not add to total due to rounding.

Finally, it appears as if households in rural Eastern Washington purchased their computers more recently than their counterparts in the Spokane area. As the table below shows, 1998 was the most common year Spokane residents reported purchasing their latest computer, whereas 2000 was the most common year for rural residents. This finding indicates, as do the ownership statistics in Table 1, that computers have been slower to penetrate into rural areas than into urban areas such as Spokane.

Table 3: Year of Newest Computer Purchase

Year newest purchase	Eastern Washington Households (2001)		
	Spokane	Remainder of E. WA	All E. WA
2001 (through Sept.)	11%	17%	15%
2000	15%	32%	26%
1999	21%	22%	22%
1998	23%	9%	14%
1997	8%	8%	8%
1996	4%	4%	4%
pre-1996	18%	7%	12%
	100%	100%	100%

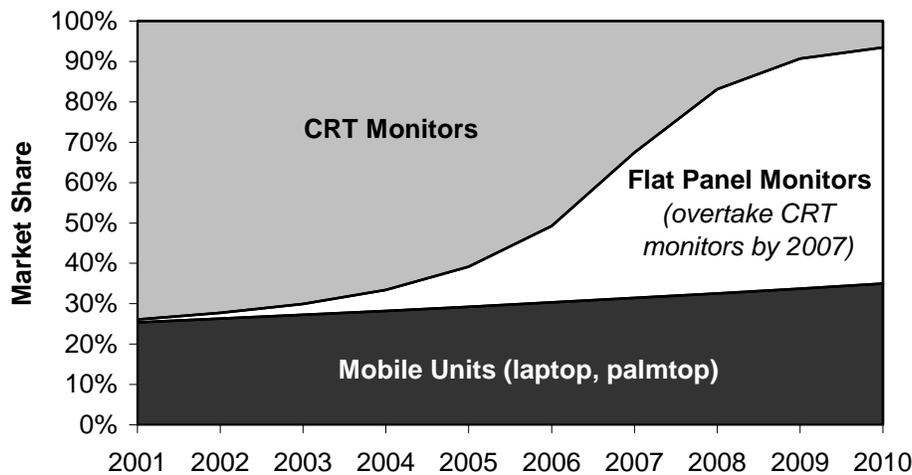
Note: Individual figures may not add to total due to rounding.

TECHNOLOGY TRENDS

COMPUTER MONITOR TRENDS

One of the strongest trends likely to influence electronic waste generation in the next few years is the rapid adoption of new monitor technologies. Forecasts by Stanford Resources,¹⁴ the leading market research firm focusing on the electronic display industry, indicate that flat-panel monitors likely will overtake traditional cathode-ray-tube (CRT) monitors in approximately 2007. In addition, forecasts by eTForecasts show that laptop and newer palmtop computers (not including personal digital assistants or PDAs) will continue their steady gains on traditional desktop units.¹⁵ Figure 1 shows a compilation of data from these two sources to illustrate the coming technological shifts.

Figure 1: Projected Computer Monitor Trends



One possibility is that as consumers purchase flat panel monitors in the next few years, they will rapidly discard their old CRT monitors. This could lead to a peak in CRT disposal sometime after 2006. Flat panel monitors will not likely become obsolete in large quantity until the next decade, beyond the immediate scope of this study. Nevertheless, flat-panel monitors will bring new challenges – although they are smaller and do not contain the several pounds of lead that CRTs do, flat-panel monitors typically contain other heavy metals such as mercury.

TELEVISION TRENDS

Like computer monitors, new flat-panel technologies are emerging to replace traditional CRT televisions. However, these technologies are not projected to grow as rapidly as

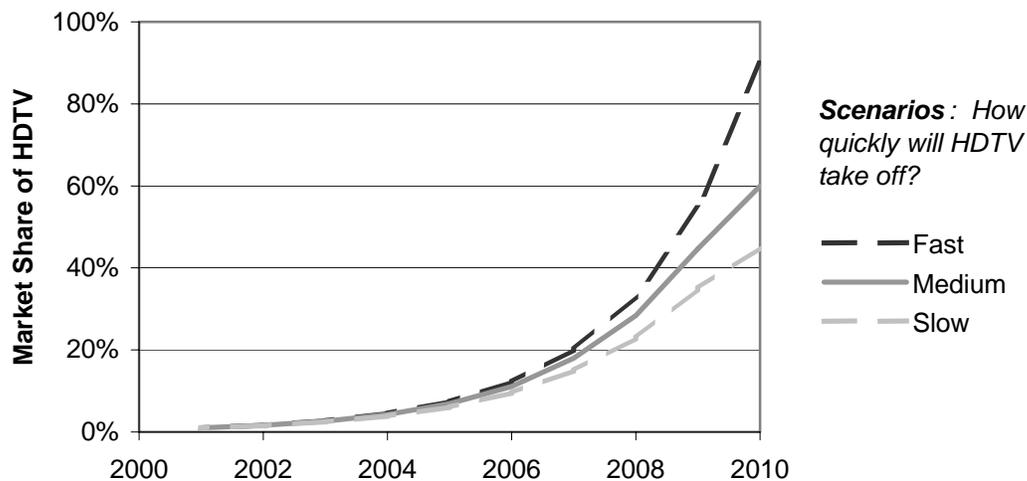
¹⁴ Stanford Resources. "Stanford Resources Forecasts LCD Demand to be Driven by Desktop Monitor Application." Press Release issued June 4, 2001. www.stanfordresources.com/press/010604.html.

Stanford Resources. "Stanford Resources Expert Forecasts Major Shifts in CRT Monitor Marketplace." Press Release issued October 2, 2001. www.stanfordresources.com/press/011002.html.

¹⁵ ETForecasts. "Worldwide PC Forecast 1990-2006: A Perspective and a top-down view of the PC Industry – Past, Present and Future Trends" www.etforecasts.com/products/1.1.

the sales of flat-panel computer monitors. According to Stanford Resources, CRT televisions will still account for about 93% of TV sales in 2007.¹⁶ And sales of digital televisions (that can accommodate high definition television, or HDTV) will still only be 20% of the marketplace in 2007. Even so, if purchase of these TVs causes consumers to discard their CRT-based units, then the technological transformation could affect e-waste generation. The following figure shows three possible scenarios for the future market share of new televisions.¹⁷

Figure 2: Possible Future Sales Growth of HDTV



The future adoption of HDTV technology is highly uncertain. Furthermore, it is not easy to forecast whether the purchase of a new HDTV will cause an old unit to be discarded or if the household will simply have one more TV, and shift existing sets to different rooms, such as to a child's bedroom or kitchen.

E-WASTE PROJECTIONS

CURRENT STOCKPILING

It is common practice for some computer and television owners to store their old equipment – likely because of the perceived value of these items, and presumably the lack of options for reselling or reusing them. Our estimates indicate that households in Eastern Washington currently have

- 170,000 stockpiled televisions;
- 180,000 stockpiled computer monitors; and

¹⁶ Stanford Resources. "Stanford Resources' Experts See Continued Growth in the TV Market with New Technologies Beginning to Erode Direct View CRT Market Share." Press Release issued January 8, 2002. www.stanfordresources.com/press/020108.html.

¹⁷ Stanford Resources estimates market share of new television technologies in 2007. Cascadia consulting constructed the three scenarios to project future technology trends beyond 2007.

- At least 180,000 stockpiled computer bases (CPUs).

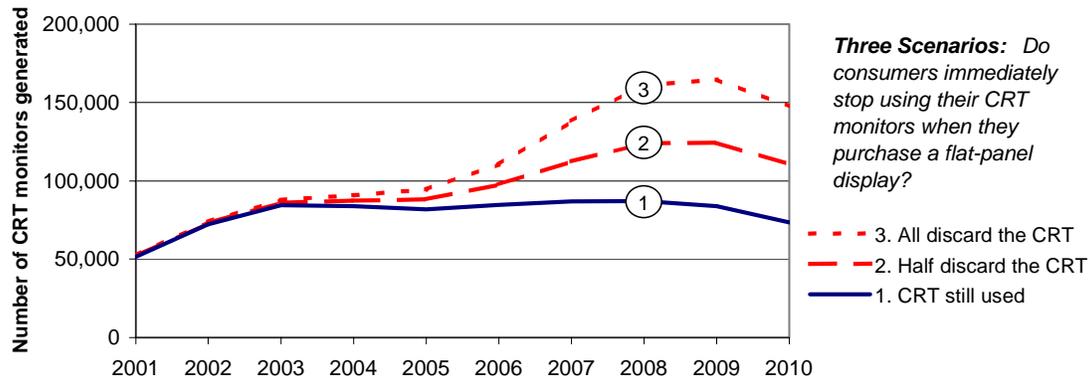
These numbers are expected to grow substantially in the next few years. Following are projections of future e-waste generation by both households and small quantity generators. Note that approximately 30 – 40% of obsolete e-waste is initially stockpiled.¹⁸

PROJECTIONS FOR HOUSEHOLDS

CRT Computer Monitors

Projections performed for this study indicate that an estimated 72,000 computer monitors became obsolete in Eastern Washington in 2002, as shown in Figure 3. This figure is expected to increase in 2003, as monitors purchased during the hi-tech “boom” of the late 1990’s continue to become obsolete. However, the number of CRT monitors becoming obsolete in future years could begin a gradual decline, as shown by scenario 1 in Figure 3. However, if the purchase of flat panel monitors causes consumers to discard their CRT monitors after less than 4 years, then the generation of obsolete monitors could continue to rise through 2009. Figure 3 shows possible future annual generation of obsolete monitors under three scenarios: 1) baseline, where consumers continue to purchase and discard new monitors on a similar schedule throughout this decade (about every 4 years); 2) accelerated obsolescence, in which half of flat-panel purchases cause a CRT monitor to become obsolete in less than 4 years, and 3) maximum obsolescence, in which every flat-panel purchased renders obsolete a CRT monitor that is less than 4 years old.

Figure 3: Possible Future Annual Generation of Obsolete CRT Computer Monitors in Eastern Washington



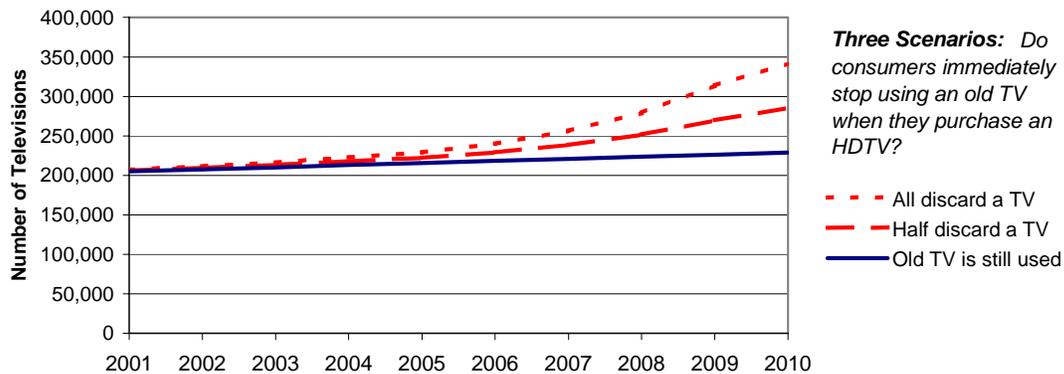
As seen in the figure above, the coming rapid conversion to flat-panel monitors creates a fair amount of uncertainty in projecting future e-waste volumes. In compiling projections of total e-waste generation, we will present both the baseline scenario (1) and the maximum, “worst-case” scenario (3).

¹⁸ California Integrated Waste Management Board. “Selected E-Waste Diversion in California: A Baseline Study.” November 2001.

Televisions

Televisions are also likely to undergo a market transformation later this decade. The following chart shows three similar scenarios regarding generation of obsolete televisions. If the purchase of an HDTV renders obsolete an otherwise functional television, then the latter part of this decade could see a rapid growth in television obsolescence, as the following figure illustrates.

Figure 4: Possible Future Annual Generation of Obsolete Televisions in Eastern Washington

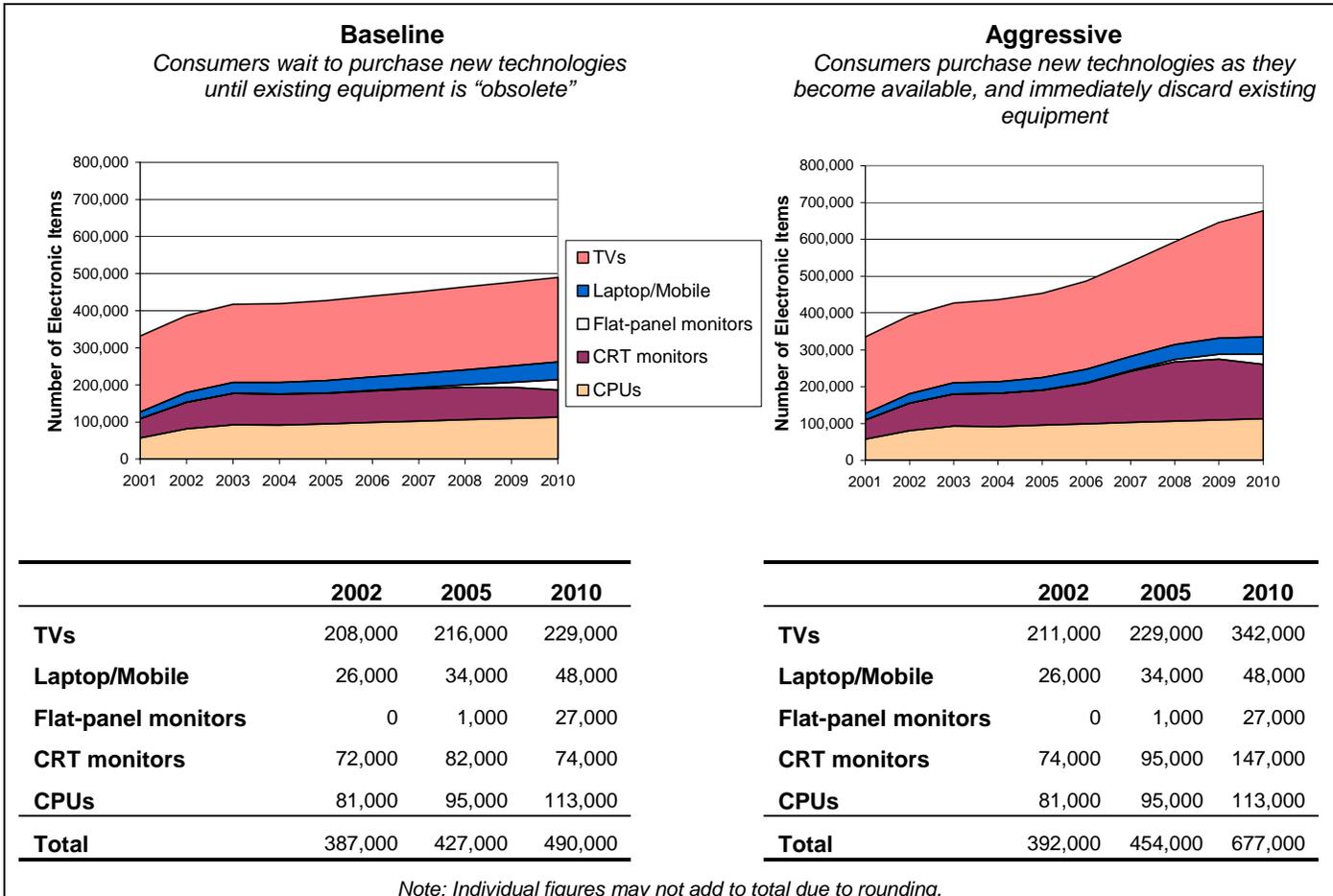


Again, given the uncertainty in predicting future consumer behavior, the summary projections, presented below, will include both baseline and aggressive estimates.

Total E-Waste Generation

The above charts show possible future generation of CRT computer monitors and televisions in Eastern Washington. Additionally, laptop, mobile, and flat-panel display computers will also become obsolete in increasing quantities in this decade. Figure 5, below, shows the consultant's baseline and aggressive estimates of future annual e-waste generation by households in Eastern Washington. Note that the figure on the right shows the potential scenario if the purchase of flat-panel monitors and HDTV causes consumers to discard items much more quickly than they presently do.

Figure 5: Annual Generation of Obsolete Electronics by Households in Eastern Washington, in number of units



Finally, note that the above charts and tables *do not* indicate existing stockpiles of electronic waste, but rather current and future *annual* generation.¹⁹ This distinction will be explored further below. Also, flat-panel monitors are only barely visible in the above charts because they are not projected to be disposed in any quantity until 2005.

Potential Waste Flow

It is important to note that not all obsolete computers are disposed. In fact, some other studies suggest that disposal can be one of the least common methods of handling obsolete electronic equipment. For example, data from a recent survey in California²⁰ suggests that approximately:

- 45% of obsolete computers were re-used (via donation or re-sale);
- 35% were stored or stockpiled;

¹⁹ Because sufficient data were not available, the estimates also do not include computers only now that were purchased before 1991 but are only now being replaced.

²⁰ California Integrated Waste Management Board. "Selected E-Waste Diversion in California: A Baseline Study." November 2001.

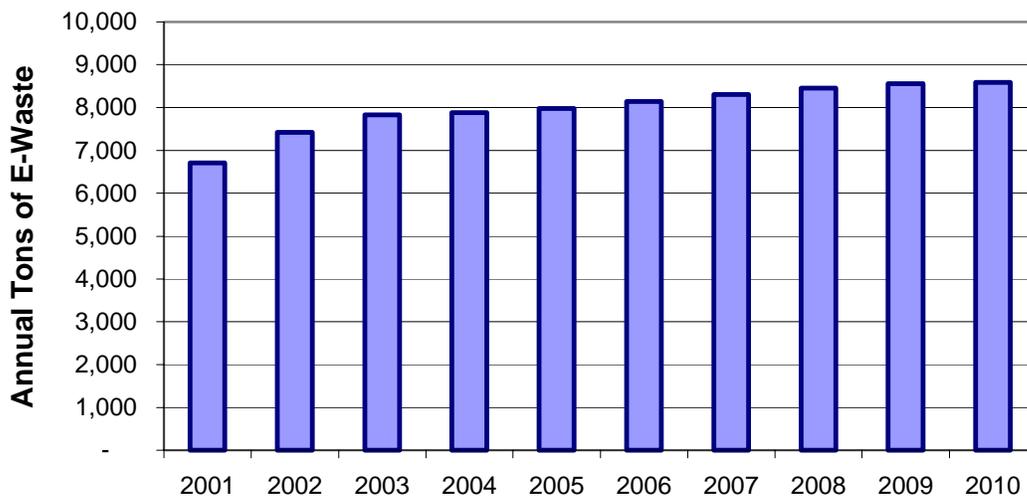
- 10% were disposed; and
- 10% were managed in some “other” way, including recycling.

If these trends hold true in Eastern Washington, then computer resellers (such as retail stores and non-profits) may currently handle tens of thousands of computers annually. In addition, large quantities of computers will continue to accumulate in storage. If 35% of all obsolete computers in Eastern Washington are stored each year (as they reportedly are in California), then the quantity of e-waste stockpiled by residents will more than double by 2006, from 530,000 units in 2001 to over 1.1 million units in 2006.

The quantity of electronic waste disposed, of course, is hard to estimate. If 10% of the obsolete computers shown in the baseline case in Figure 5 are disposed by residents, then Eastern Washington could see over 8,000 CPUs and 7,000 CRT monitors disposed in 2002, not counting the donated, unusable units that are then disposed by resellers.

The total weight of all the obsolete electronics generated annually by Eastern Washington households is several thousand tons.²¹ Figure 6, below, shows the estimated annual weight of electronic waste, for the baseline case.

Figure 6: Annual Generation of Obsolete Electronics by Eastern Washington Households, by weight



Note that this quantity of obsolete electronics is equal to 0.5 units, or about 21 pounds, per household per year in 2001 increasing to 0.7 units, or about 24 pounds, per household per year in 2010. If all of these units were disposed, it would comprise about 1% of the residential municipal solid waste in Eastern Washington.²²

²¹ Weight estimates were conducted by assuming 50 lbs per television, 30 pounds per CRT, 26 pounds per CPU, and other assumptions as detailed in Appendix A.

²² Assuming each of the 650,000 households in Eastern Washington generates about 1 ton of solid waste annually, then about 650,000 tons of solid waste were generated in Eastern Washington in 2001. At about 6,700 tons of generation in 2001, the total e-waste is about 1% of this total.

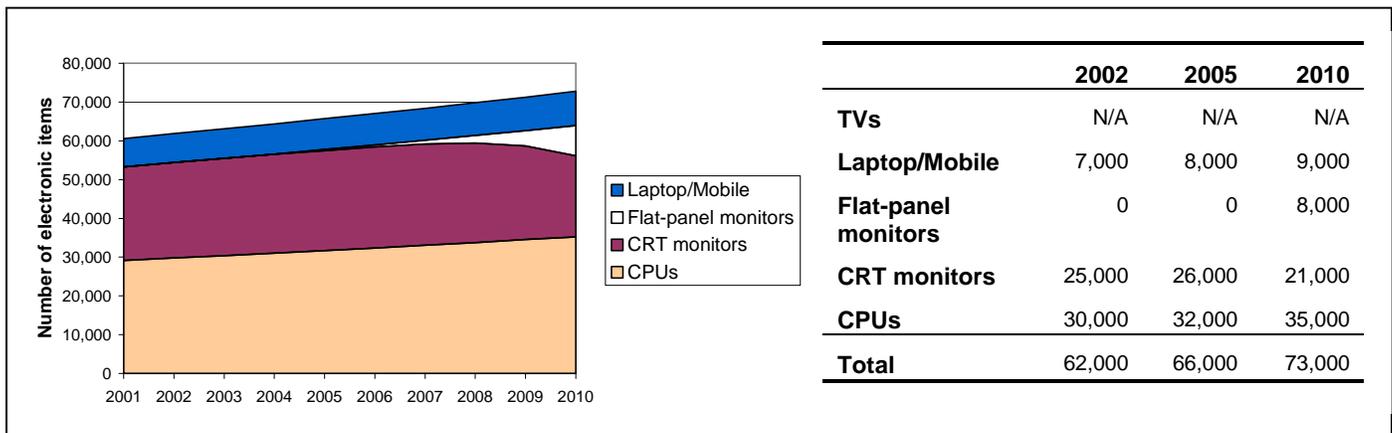
GENERATION OF ELECTRONIC WASTE BY SMALL QUANTITY GENERATORS (SQGs)

In addition to estimates for Eastern Washington households, this study also estimates the current and future generation of computer waste from businesses that do not generate large quantities of dangerous waste, including e-waste. However, because extensive survey information was not available for this sector, the consultant takes a more simplified approach.

As discussed under the “Methodology” heading, above, projections for SQGs are based on employment projections (by two-digit SIC code) for Eastern Washington produced by the Washington Office of Financial Management (OFM). These estimates were then combined with estimates of the average number of computers per employee, also by industry group, compiled by the Energy Information Administration in 1999. These individual estimates are included in Appendix A.

The following figure displays the estimated annual generation of computer waste by small quantity generators (SQGs) in Eastern Washington. Note that these projections do not include televisions because televisions are not nearly as prevalent in business as they are in residences, and because little information was available on TV use by industry sectors.²³

Figure 7: Annual Generation of Obsolete Electronics by SQGs in Eastern Washington, in number of units



Note that the quantities of computers generated by SQGs are projected to be much less than those generated by residents. However, it is important to keep in mind that these projections are less rigorous, and involve more uncertainty, than the residential projections. This is because less information is available, as well as the difficulty in determining how many and what type of businesses are truly “small quantity generators.” In this study we assumed that all businesses in certain SIC codes were SQGs (such as agriculture, hotels, and restaurants) while all businesses in other SIC codes were “fully

²³ The figure also does not account for the potential rapid discarding of CRT-based monitors in favor of flat-panel displays. This assumption actually may be realistic given that most businesses are probably not as likely to discard monitors, because of economic considerations.

regulated generators” (such as educational institutions, health care facilities, and factories). This type of assumption, although necessary for these calculations, is inherently limiting. Nevertheless, the above SQG projections should be considered reasonable planning-level estimates.

3. Current Services and Policies

Between November 4 and 21, 2002, the consultant conducted a telephone survey of local governments, landfill and transfer station operators, waste hauling companies, health districts, and non-profit organizations located in Eastern Washington. Survey forms were customized to each type of respondent, and were designed to elicit information about current practices and policies related to the collection, handling, reuse, recycling, and disposal of electronic waste. A total of 69 entities²⁴ were surveyed; Table 4 below provides further detail.

Table 4: Entities Surveyed

Entity	Number Surveyed
Local Governments	23
Landfill and Transfer Station Operators	13
Waste-to-Energy Facility	1
Moderate Risk Waste Facility	1
Health districts	10
Waste Haulers	10
Non-profits and Businesses	11
Total	69

This survey was designed to capture a wide range of perspectives and information about electronics waste and disposition given available time and resources, but was not designed to provide statistically significant results.

This survey was intended to answer the following questions:

- Which facilities accept e-waste? What types of e-waste are accepted at each facility?
- What policies and practices are in place regarding cathode ray tubes (CRTs) generated by fully regulated and small quantity generators, households, and non-profits?
- What services are provided to households and small quantity generators?
- What are future plans or anticipated programs for collection of e-waste?
- What do respondents consider to be “convenient” collection services for e-waste, based on experience with other materials and programs?

²⁴ One additional transfer station operator, Kittitas County, was surveyed, but since they no longer accept waste at their transfer stations, results are reported for thirteen landfills and transfer stations rather than fourteen.

The remainder of this section presents the results of the survey, organized by the questions listed above.

WHICH FACILITIES ACCEPT E-WASTE? WHAT TYPES OF E-WASTES ARE ACCEPTED?

As part of this survey, we asked landfill and transfer station operators, Moderate Risk Waste and Waste-to-Energy facility operators, health districts, waste haulers, and non-profits, charities, and businesses whether they accept e-waste at their facilities for any type of handling. Table 5 shows the results of these questions.

Health districts were surveyed because they regulate landfills. Although a total of ten Health districts were surveyed, one district reported that the landfill in its district had closed, so results are reported for nine districts.

Table 5: Facilities that Accept E-waste For Disposal

Facility Type	Handle E-Waste for Disposal?		Accept E-Waste for Reuse?	Accept E-Waste for Recycling?
	Yes	No		
Landfills and Transfer Stations	11	2	0	0
Moderate Risk Waste Facility	0	1	0	0
Waste-to-Energy Plant	1	0	0	0
Health Districts	8	1	0	0
Waste Haulers	3	7	0	0
Non-profits, charities, and businesses	0	11	11	0

Two of the waste haulers that do not accept e-waste qualified their answers, saying that they do not accept e-waste unless it is mixed with the mainstream waste.

All eleven non-profits, charities, and businesses surveyed reuse electronics, usually through resale but sometimes through donation to schools or non-profits. Two of the businesses surveyed reported that they also reuse e-waste through stripping obsolete computers for parts. None of the non-profits, charities, and businesses recycles e-waste.

When asked what types of electronics their facilities accept, all of the landfills and transfer stations, waste-to-energy facilities, health districts, and waste haulers that accept e-waste reported that their facilities take all types of electronics. Only the non-profits, businesses, and charities showed some variety, perhaps due to the varying nature of their enterprises. Table 6 summarizes the responses from the non-profits, charities, and businesses.

Table 6: Types of E-waste Accepted by Non-profits, Charities, and Businesses

Types of E-waste Accepted	Number of Respondents	Notes
All	4	One respondent noted that they mostly take computers and TVs because other items just don't come in.
All but cell phones	1	
Anything except computers	2	One respondent said they don't take computer-related items because "we can't dispose of them in the dumpster."
Anything except computers and TVs	1	The respondent said the fees for disposal at the landfill for these items became too high.
Computers only	2	
Functional computers only	1	

WHAT POLICIES AND PRACTICES ARE IN PLACE REGARDING CRTs GENERATED BY FULLY REGULATED GENERATORS, SMALL QUANTITY GENERATORS, HOUSEHOLDS, AND NON-PROFITS?

Landfills and Transfer Stations

For this study, we surveyed seven operators of landfills and six operators of transfer stations. As Table 7 shows, of the thirteen landfills and transfer stations surveyed, only one transfer station refuses to accept e-waste, including CRTs, from households (one other transfer station takes waste only from commercial haulers). The remaining eleven facilities accept all types of e-waste from households, although one transfer station allows self-haulers to bring only one unit per customer and one charges a disposal fee.

Two of the landfills and four of the transfer stations surveyed do not accept e-waste from small quantity generators. Those that do take e-waste accept all types of electronics, including CRTs. One landfill that accepts e-waste from small quantity generators is actively trying to change this policy.

Only two of the landfills surveyed accept electronics from fully regulated generators. These two disposal sites take all types of electronics, including CRTs. None of the transfer stations surveyed accept e-waste from fully regulated generators. However, it is interesting to note that two of the landfills and two of the transfer stations surveyed reported that there are no fully regulated generators in the areas they serve.

In addition, two transfer stations and two landfills turn commercial haulers away if their loads contain e-waste. However, one of the transfer stations that turns haulers away simply refers them to the neighboring landfill. Of the eight operations that don't turn haulers away, one transfer station does not accept any waste from commercial haulers at all, and another transfer station accepts mostly construction and demolition wastes wherein electronics are not much of an issue.

Table 7: Landfills and Transfer Stations' Policies Regarding CRTs and E-waste

Generator Type	Landfills		Transfer Stations		Notes
	Accept E-waste, Including CRTs?		Accept E-waste, Including CRTs?		
	No	Yes	No	Yes	
Households	0	7	1	4	One additional transfer station does not accept any waste from self-haulers.
SQGs	2	5	4	2	
Fully Regulated Generators	5	2	0	6	Four stations say there are no fully regulated generators in their catchment areas.
Commercial Haulers	2	5	2	3	One additional transfer station does not accept any waste from commercial haulers at all.

Moderate Risk Waste and Waste-to-Energy Facilities

The survey included one moderate risk waste (MRW) facility and one waste-to-energy (WTE) facility. Table 8 shows their policies regarding acceptance of e-waste, including CRTs.

The MRW facility does not accept any type of e-waste from anyone, and turns commercial haulers away if their loads contain e-waste. In contrast, the WTE facility accepts all types of e-waste from all types of generators, including fully regulated generators, if the e-waste is mixed with mainstream waste. The waste-to-energy facility does not plan to change its policies.

Table 8: Moderate Risk Waste and Waste-to-Energy Facilities' Policies

Generator Type	Accept E-Waste, Including CRTs?	
	Moderate Risk Waste Facility	Waste-to-Energy Facility
Households	No	Yes
SQGs	No	Yes
LQGs	No	Yes
Commercial Haulers	No	Yes

Health Districts

Health districts regulate landfills, so their answers to the survey questions provide insight into regulators' policies regarding e-waste disposal at landfills. Ten health districts were surveyed. Of these, one health district no longer regulates landfills because the landfill in its district was closed (Kittitas County). Therefore, results in Table 9 are presented for nine health districts.

All but one of the nine health districts that still regulate landfills say their landfills accept e-waste. The one that does not may have conflated e-waste with appliances, because the respondent stated, "everything goes to white goods recycling at the waste-to-energy plant." However, although one respondent stated that the landfill accepts e-waste if it is mixed with the mainstream waste, he also said that the county accepts TVs and computer monitors free of charge and does not send them to the landfill.

One of the health districts did not specify which types of electronics its landfill accepts. The others said their landfills take all types of e-waste for disposal, including CRTs. Seven districts said their landfills accept waste from all types of generators, while one said its landfill's restrictions are in compliance with Washington State law.

Four health districts weren't sure if their landfills turn commercial haulers away if their loads contain e-waste. One health district said its landfill did turn commercial haulers away, and one said that the landfill would turn them away if the operators were aware that e-waste were in the load, but the landfill handles too much volume to check every load. One health district said that commercial haulers rarely go to its landfill.

None of the health districts are planning to change their policies to ban e-waste generated by households and small quantity generators. Four health districts said they would not institute such a ban unless state regulations changed to require it, and one said that an alternative to disposal would need to be in place first.

Of the ten health districts surveyed, only two said they were aware of the Department of Ecology's Interim Enforcement Policy for CRTs.

Table 9: Health District E-waste Policies

Generator Type	Accept Electronic Products in Landfills?			Considering Changing Policies to Ban E-waste from Households and SQGs?	
	Yes	No	Not Sure	Yes	No
Households	8	1	0	0	9
SQGs	8	1	0	0	9
LQGs	7	2	0	N/A	N/A
Commercial Haulers	1	3	4	N/A	N/A

Interestingly, the responses from health districts did not always match the responses of the landfills and transfer stations they regulate. Table 10 compares the answers of

landfill and transfer station operators to those of their corresponding health districts regarding whether the disposal sites accept e-waste, and from whom. Answers that do not match are shown in bold text.

Table 10: Comparison of Health District Policies and Landfill and Transfer Station Practices

Landfill or Transfer Station Surveyed	Health District	Accept from residents?		Accept from SQGs?		Accept from Regulated Generators?	
		Station	District	Station	District	Station	District
		Asotin County Landfill	Asotin	Yes	Unsure	Yes	Not sure
Columbia Transfer Station	Columbia	No	Not surveyed	No	Not surveyed	No	Not surveyed
Garfield County Transfer Station	Garfield	Yes	Not surveyed	No	Not surveyed	No	Not surveyed
Greater Wenatchee Regional Landfill	Chelan-Douglas	Yes	Not surveyed	No	Not surveyed	No	Not surveyed
Lincoln County Transfer Station	Lincoln	Yes	Not surveyed	Yes	Not surveyed	No	Not surveyed
Okanogan County Landfill	Okanogan	Yes	Yes	Yes	Yes	No	Yes
Regional Disposal Company	Klickitat	Yes	Yes	Yes	Yes	No	Yes
Roosevelt Regional Landfill	Klickitat	Yes	Yes	Yes	Yes	No	Yes
Stevens County Landfill	Northeast Tri-County	Yes	Unsure	Yes	Not sure	Yes	Not sure
Sudbury Road Landfill	Walla Walla	Yes	Yes	No	Yes	No	Yes
Sunshine Disposal	Adams County & Spokane	No	No	No	No	No	No
Wenatchee Transfer Stations	Chelan-Douglas	Yes	Not surveyed	No	Not surveyed	No	Not surveyed
Yakima County Public Works	Yakima	Yes	Yes	Yes	Yes	Yes	No

Intriguingly, it appears from these answers that health districts' policies are more permissive than the landfills and transfer stations themselves, except in Yakima. However, our surveyor found that some health district respondents were not very familiar with the district's policies on e-waste or Ecology's Interim Enforcement Policy

(<http://www.ecy.wa.gov/biblio/0204017.html>), even though the district identified the respondent as the most appropriate person to answer our survey. Some told our surveyor that they could find the answers if they looked at the permit, but did not have time to do so. Therefore, the most probable reason for these discrepancies is that some health district respondents did not have immediate access to the details of their policies on acceptance of e-waste at landfills and transfer stations when surveyed.

Also, it is important to note that some health districts regulate transfer stations that ship waste to landfills that are regulated by a different health district. Table 11 shows the relationships between transfer stations surveyed, and landfills and health districts, to the best of the consultant's knowledge.

Table 11: Landfills Receiving Waste from Surveyed Transfer Stations and the Health Districts that Regulate Them

Transfer Station Surveyed	Health District Regulating Transfer Station	Ships Waste To	Health District Regulating Facility
Columbia Transfer Station	Columbia	Sudbury Road Landfill, BDI Transfer Station, Whitman County Transfer Station	Walla Walla, Benton-Franklin, Whitman
Garfield County Transfer Station	Garfield	Asotin County Landfill	Asotin
Kittitas County Transfer Stations	Kittitas	Greater Wenatchee Regional Landfill	Chelan-Douglas
Lincoln County Transfer Station	Lincoln	Delano Landfill, Sunshine Recycling Transfer Station, Roosevelt Regional Landfill	Grant, Spokane, and Klickitat
Regional Disposal Company	Klickitat	Klickitat County	Klickitat
Sunshine Disposal	Adams County & Spokane	Adams County & Spokane	Adams County & Spokane
Wenatchee Transfer Stations	Chelan-Douglas	Greater Wenatchee Landfill	Chelan-Douglas
Yakima County Public Works	Yakima	Terrace Heights Landfill and Cheyne Road Landfill	Yakima

Other transfer stations in Eastern Washington send waste to landfills that are in different counties and regulated by different health districts. For example, transfer stations in Ferry County, Pend Oreille County, Whitman County, Franklin County, and Adams County send waste to the Roosevelt Regional Landfill in Klickitat County. Transfer stations in Spokane County send waste to the Spokane Waste-to-Energy Plant and the Northside Landfill, both in Spokane County, but also send some waste to Roosevelt Regional Landfill. Grant County transfer stations send waste to the BDI Transfer Station in Franklin County as well as to the Ephrata and Delano Landfills in Grant County. Lastly, transfer stations in Walla Walla County send waste to the Whitman County Transfer Station in Whitman County and the BDI Transfer Station in Franklin County in addition to the Sudbury Road Landfill in Walla Walla County.

Waste Haulers

Of the ten waste haulers surveyed, three said that they do accept electronics, two said that they accept electronics only if they are combined with mainstream waste, and five said that they do not accept electronics at all. Two of the three haulers that do accept electronics take them from households only; the third accepts electronics from all types of generators. All three haulers dispose the e-waste in landfills, although one is working with Douglas County to develop a better alternative. However, none of the three plan to discontinue hauling electronics.

Non-profits, Charities, and Businesses

We surveyed two businesses, two non-profit foundations, and seven charities such as Goodwill and the Salvation Army. As reported above, all eleven organizations accept electronics, although two won't accept computers and one won't accept computers and televisions. Of the eight that accept CRTs, five accept them from all types of generators, two reported accepting them from mostly households and businesses, and one accepts them only from state government.

WHAT SERVICES ARE PROVIDED TO HOUSEHOLDS AND SMALL QUANTITY GENERATORS?

This question probed for details about current services that landfills and transfer stations, moderate risk waste and waste-to-energy facilities, waste haulers, non-profits, and local governments provide to households and small quantity generators.

Of the thirteen landfills and transfer station operators surveyed, only one offered any services to households and small quantity generators besides disposal. This transfer station operator offers to take electronics to the local Care and Share if it is a usable item.

The waste-to-energy plant does not offer any services to households and small quantity generators besides disposal. However, the moderate risk waste facility participated in a one-day collection event for recycling e-waste, and hopes to make it an annual service.

Of the ten waste haulers surveyed, seven provide technical assistance to businesses regarding hazardous waste. Eight provide referrals for e-waste specifically.

One of the charities surveyed said that in addition to accepting electronics, they also refer customers to a local recycling center. The others do not offer any additional services to households and businesses.

Currently, some local governments provide reuse and recycling services for households and small quantity generators. For example, Benton County, City of Kennewick, Chelan County, and the City of Richland have each held one collection event. None of the local governments provide technical assistance to households or small quantity generators to help them reuse or recycle e-waste.

Washington State University operates a computer-recycling program. They ship the monitors to Utah for disassembly and sell the computers for scrap. This program accepts computers only from Washington State University campuses.

WHAT ARE FUTURE PLANS OR ANTICIPATED PROGRAMS FOR COLLECTION OF E-WASTE?

As a follow-up to the question about current services, we asked transfer station and landfill operators, moderate risk waste and waste-to-energy facility operators, waste haulers, non-profits, and local governments whether they plan to add any services for collection of e-waste.

None of the transfer station and landfill operators plan to offer any additional services, although one said that it depended upon what state law and permits require, and another said that he would like to do so, but needs a recycling facility close by. Although the waste-to-energy plant does not plan to offer any additional services, the moderate risk waste facility hopes to participate annually in the one-day collection event. None of the non-profits, businesses, and charities plan to institute any additional services, although one charity is interested in doing so. Similarly, none of the waste haulers plan to add any services for e-waste.

Some local governments, on the other hand, are planning to add e-waste services. Of the twenty-two local governments surveyed, seven definitely are planning to add e-waste to their services, three may add e-waste, and twelve have no plans to add e-waste to their services. Planned and potential services include the following:

- Kittitas County plans to offer a collection event in the spring of 2003.
- Klickitat County is exploring its options, and is looking at StRUT²⁵ as a model.
- Douglas County is working with the Department of Ecology (Yakima), Kittitas and Chelan Counties, and Total Reclaim (Seattle) to develop a pilot program to collect e-waste from businesses. Their goal is to make the program viable, expand it to households, and eventually hand the program over to the private sector.
- Chelan County and the City of Richland plan to make their one-day collection event an annual service.
- Benton County and the City of Kennewick are hoping to make their collection event an annual service, but require additional funding.
- Yakima County and Ferry County each will study the e-waste issue in 2003.

One local government respondent stated that when state regulations require e-waste services, they would add them. Another local government representative said that she is interested in adding e-waste services, but has no funding available to do so.

²⁵ StRUT stands for Students Recycling Used Technology. According to the StRUT website, <http://www.strut.org/>, StRUT is a program in which students evaluate and repair used computers and then donate them to schools.

WHAT DO RESPONDENTS CONSIDER TO BE “CONVENIENT” COLLECTION SERVICES FOR E-WASTE, BASED ON EXPERIENCE WITH OTHER MATERIALS AND PROGRAMS?

We asked all survey respondents what characteristics an e-waste recycling program would have to have in order for Eastern Washington residents to consider it convenient. Above all, respondents agreed that any program must be free or at minimal cost to residents. A summary of responses is provided below.

- **Locations and hours must be convenient.** Respondents did not define convenience in terms of miles traveled, but most said either a “central” location or multiple sites scattered throughout the area would work.
- **Respondents seemed to think that either periodic collection events or a variety of drop-off sites would work.** If drop-sites were chosen, respondents suggested adding them to existing recycling centers, household hazardous waste facilities, or transfer stations and landfills. Some respondents who favored drop sites noted that the ability to visit the sites at any time is a benefit.
- **Some respondents suggested expanding existing programs such as household hazardous waste facilities or collection events.**
- **Many respondents emphasized the need for extensive education and advertising of any program.**
- **Some respondents indicated interest in seeing product-stewardship programs** such as deposits at the time of purchase or buy-back programs.
- **As mentioned above, many respondents indicated that any program must be free or at minimal cost.**

4. Assessment of Service Needs and Product Stewardship Opportunities

This section builds upon the information presented in the previous sections to identify new services needed to create or expand electronics collection, reuse, refurbishing, and recycling in Eastern Washington. It also examines ways to meet those needs in the context of regional and national product stewardship initiatives.

Specifically, this section provides answers to the following questions:

- What level of service could be considered “convenient” for rural as well as more urban areas of Eastern Washington?
- What new services may be necessary to handle the projected e-waste flows?
- What opportunities exist for local and/or small businesses and organizations to provide these services, potentially in collaboration with other public, non-profit, and/or regional or national entities?
- What opportunities exist for product stewardship programs to provide these services?

The answers to these questions were developed using limited hard information on the service needs and opportunities and the public’s conception of convenient services. Therefore, they should be treated with caution. At the conclusion of this section, we identify places where additional research or analysis is necessary to provide more definitive conclusions for planning purposes.

ASSESSMENT OF SERVICE NEEDS

As Chapter 1 of this report describes, homes and small businesses in Eastern Washington generated approximately 350,000 units of obsolete electronics in 2002. This situation will only worsen as new technology, such as flat-screen monitors and high-definition televisions, penetrates the market. According to our calculations, as soon as 2005 residents and businesses in Eastern Washington will produce over 500,000 units of obsolete electronics annually.

The survey conducted for this study indicates that currently services to refurbish electronics, especially computers, are limited in Eastern Washington. Some non-profits, charities, and businesses accept electronics for resale, but most reported that they cannot handle much more volume than they do currently. According to our survey, services for recycling electronics are even more limited – a few local governments have held collection events, and others are investigating doing so. But in general, the infrastructure to recover e-waste over the next three to eight years does not yet exist.

This section frames the decisions that Washington State faces due to the uncertainty inherent in national product stewardship initiatives, and outlines new e-waste services that, according to our survey, residents of Eastern Washington might find convenient. Lastly, it identifies the ways to finance these new services, including developing product stewardship programs.

Decision Point: NEPSI

Washington State is not alone in its desire to divert e-waste from the landfill: this issue has risen to national prominence among governments and environmental groups in the past decade. As a result of the growing concern about the effects of e-waste disposal on the environment, and as well as an increasing desire to involve manufacturers and retailers in the responsibility for handling products at the end of their useful lives, a variety of stakeholders have begun to develop product stewardship initiatives for e-waste. (See Appendix B for more detail about product stewardship initiatives.)

Currently, the National Electronics Product Stewardship Initiative, or NEPSI, is negotiating draft recommendations for a national product stewardship program with the following characteristics:

- Consumers would pay an upfront fee on the purchase of new electronics to cover the costs of collecting, transporting, and recycling stockpiled electronics.
- Once the stockpiles of electronics are reduced or eliminated, the upfront fee would be eliminated, and the electronics industry would absorb or internalize the costs of disposal.
- The funding generated through this two-step program would pay for a baseline level of collection, transportation, and processing of obsolete electronics. Local governments would be responsible for advertising the services or otherwise enhancing them in any way.²⁶

Catherine Wilt, staff to NEPSI, estimates that NEPSI will begin its deliberations on these recommendations in February 2003, and take several meetings to reach a conclusion.²⁷ Even if the NEPSI participants are able to agree on a program, federal legislation will still be needed to enact the fee structure. Therefore, it is reasonable to postulate that a national product stewardship program would not be in place until 2004 at the earliest.

Given that national context, Washington State faces a decision: it could wait to see what develops from the NEPSI process, or begin planning for e-waste collection and handling systems now. The consultant team recommends beginning to plan for e-waste collection and recycling programs now, for the following reasons:

- The recommendations currently on the table at NEPSI involve collection, handling, and processing infrastructure. If Washington State begins to plan now for creating such infrastructure, the NEPSI program could begin more quickly once the federal legislation is in place and fees begin to be collected to pay for the infrastructure.
- NEPSI still faces two significant challenges: agreement on a program at the NEPSI forum, and passage of federal legislation. The process could break down at either of these two points. If Washington State begins planning for e-waste recycling services now, the state will be prepared to implement its own programs quickly if the NEPSI process falls through.

It may behoove the state to prepare two plans: one for recycling programs under NEPSI, and one for programs without NEPSI. Thus, the state will be able to adapt to circumstances as they unfold.

²⁶ *E-Scrap News*, Volume 2, No.12, December 2002. Page 1.

²⁷ Catherine Wilt, personal communication to Laura Blackmore, December 4, 2002, Seattle, WA.

The sections below discuss the types of services that state and local governments could consider implementing in Eastern Washington for the collection and processing of e-waste, either on their own or through encouraging local product stewardship initiatives. The findings in these sections are based upon the consultant team's professional judgment and the knowledge of Eastern Washington that we gained through our research for this study.

Level of Service

As discussed above in Chapter 3, respondents to the survey overwhelmingly said that "convenient" services would have to be free, and would have to be offered at either "central" or "multiple" locations. Although respondents did not specify what "convenient" locations would be, several options seem logical:

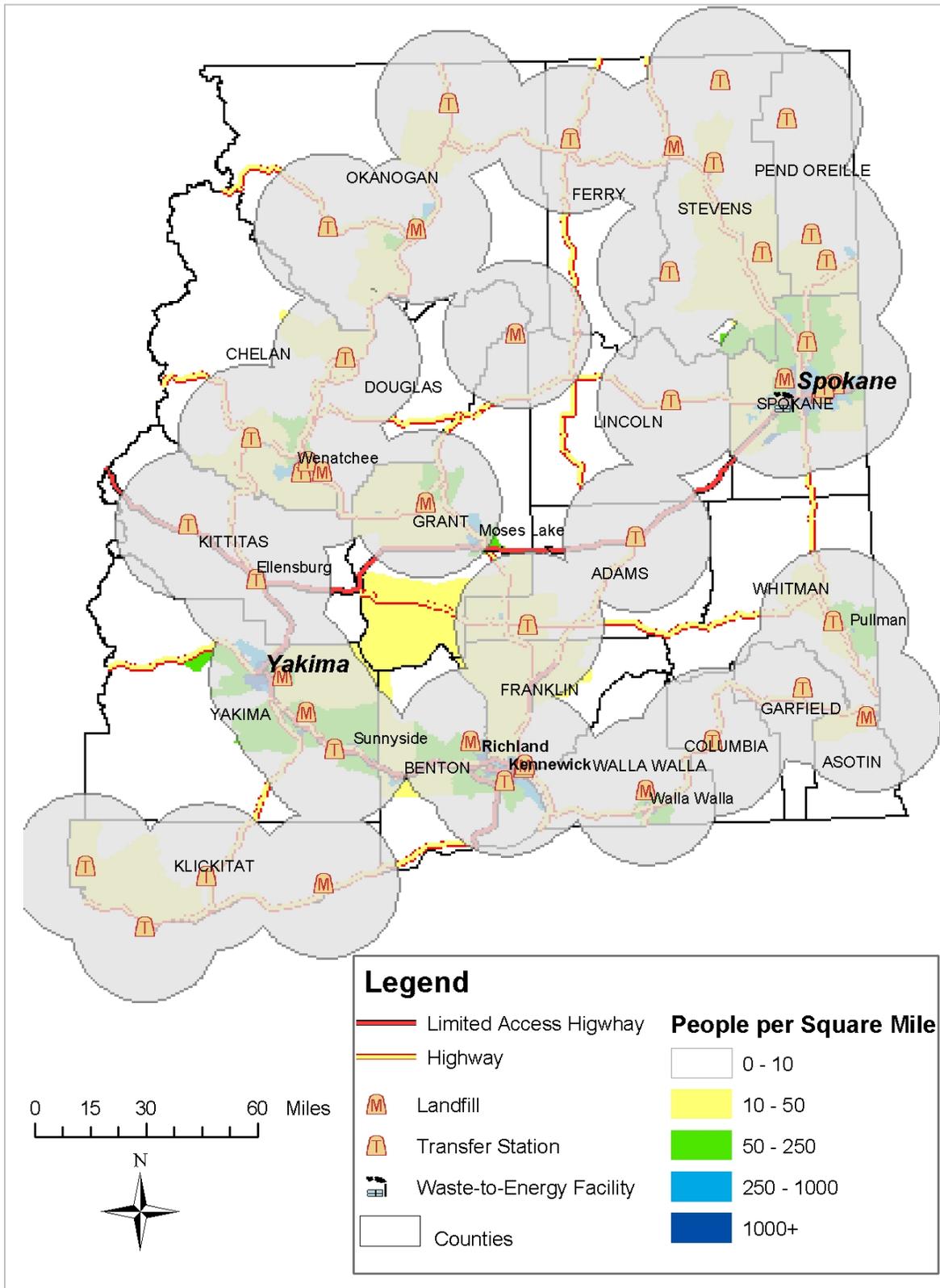
- Offer services at transfer stations and landfills where residents and small quantity generators self-haul wastes. Since these generators already are willing to travel to these locations, they either already find them convenient or would consider the ability to recycle e-waste at the same time they dispose of garbage convenient.
- Offer services at existing recycling depots. Like the transfer stations and landfills, many residents of and businesses in Eastern Washington already use these facilities.
- Add e-waste to existing household hazardous waste collection programs.
- Work with retailers to offer services on-site.
- Work with manufacturers to establish take-back programs.

The latter two options are product stewardship programs. However, the first three options could be offered as government services or as product stewardship programs. For example, manufacturers and/or retailers could pay for the operation of drop boxes at transfer stations or landfills, or could cover the costs of adding e-waste to household hazardous waste collection programs.

Services at transfer stations, landfills, and recycling depots likely would consist of drop-boxes. It is important to note that because there is no way to prevent breakage of items placed in drop-boxes, these programs likely would preclude refurbishment or reuse of obsolete electronics. Therefore, adding e-waste to collection events or working with retailers and manufacturers to establish product stewardship programs may be preferable because these options could accommodate reuse or refurbishment.

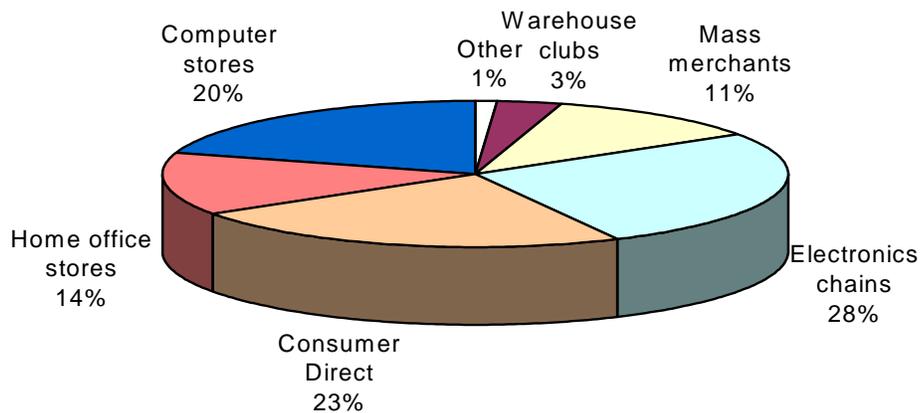
Although respondents did not specify how close a collection site would need to be for them to consider it convenient, one model for convenience could be the distance that residents are willing to travel to existing transfer stations and landfills or recycling centers. The data from the survey shows that residents travel between 5 and 60 miles to reach existing facilities, and commonly travel up to 20 miles. Figure 8 shows the areas of Eastern Washington that are within 20 miles of transfer stations and landfills. As the map shows, the majority of Eastern Washington is within what might be considered "convenient" driving distance of an existing facility that could host e-waste collection services. In fact, the only region with population density more than 10 people per square mile that isn't currently within 20 miles of a transfer station or landfill is a small region southwest of Moses Lake, a town that is served by waste drop boxes rather than staffed transfer stations.

Figure 8: Regions of Eastern Washington that are within 20 miles of existing landfills and transfer stations
Areas not covered by a grey circle are further than 20 miles from a facility



One option for establishing convenient services while working toward a product stewardship program is to work with one or more major retailers in Eastern Washington to establish collection services on-site. Many local government representatives contacted for this study expressed support for and interest in developing product stewardship programs. TWICE, a market research firm, estimates that nearly 80% of computer sales nationwide occur at brick-and-mortar retail stores rather than over the Internet, so traditional retailers are a logical partner for product stewardship programs. Figure 9 shows that electronics chains and computer stores account for nearly half of computer sales nationwide.

Figure 9: National Computer Sales by Type of Retailer²⁸



Once the retail collection centers were established, the state could determine where additional services still were needed, and work with local governments to develop other drop-box sites or collection events.

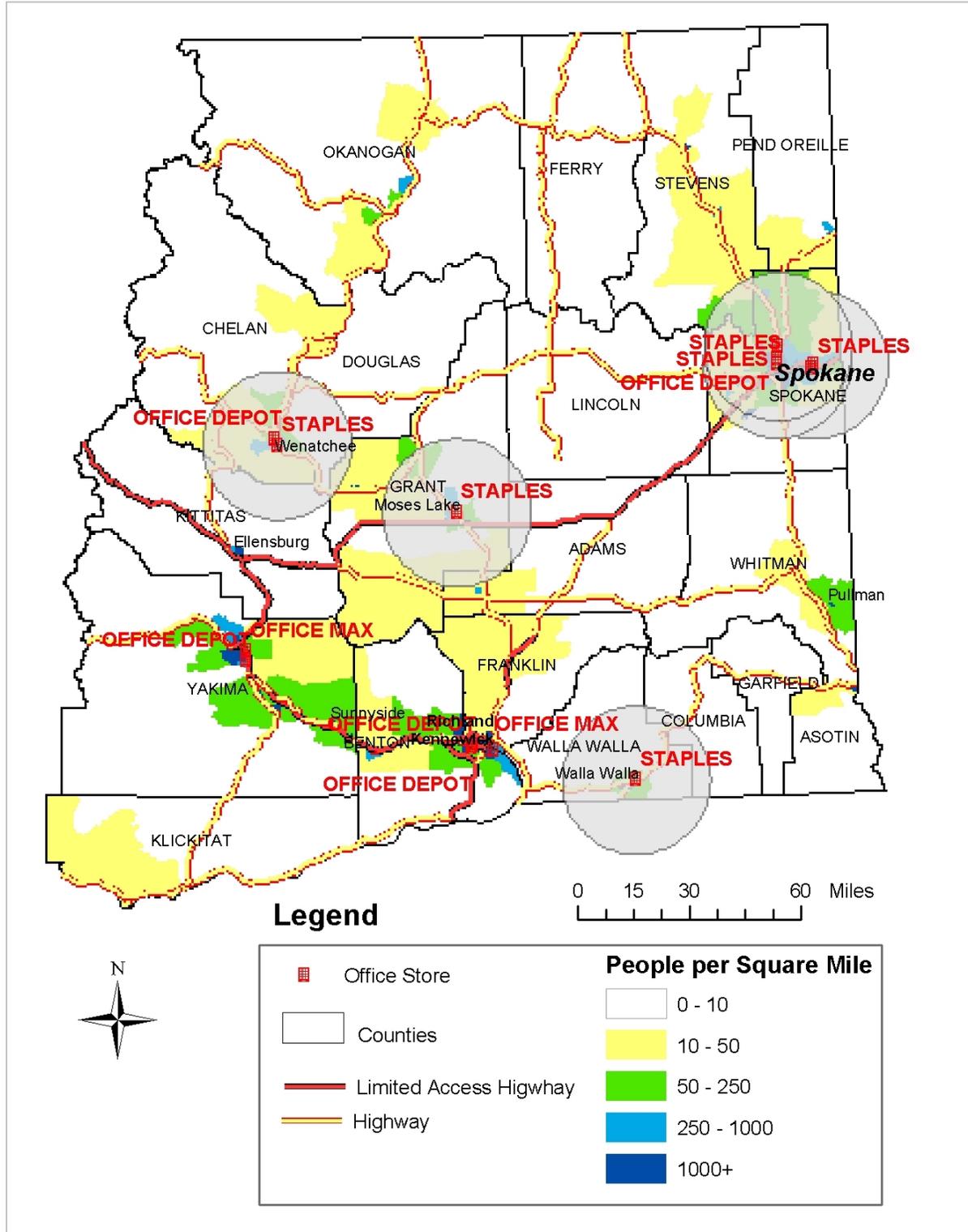
Purely as a hypothetical exercise to illustrate this option, the consultant team selected one retailer in Eastern Washington, Staples, and created a map (Figure 10) showing what areas of Eastern Washington would be served if all of their stores established collection services, assuming that people would travel 20 miles to each store. Note that the Spokane, Wenatchee, Moses Lake, and Walla Walla metropolitan areas have Staples stores, but that Yakima and the Tri-Cities do not. Although home office stores such as Staples account for only about 14% of nationwide computer sales, in 2002 Staples offered a nationwide take-back event for computers.²⁹ Therefore, Staples may be a logical choice for initial partnering. However, it is important to note that Staples has not otherwise indicated any interest in product stewardship programs to the consultant team: this is an entirely hypothetical example.

²⁸ TWICE Market Research, as reported in Olenick, Doug. "PC Product Sales dip 2.2% in 2001." *This Week in Consumer Electronics* vol. 17:15, 2002, p 28.

²⁹ <http://www.eiae.org/whatsnew/news.cfm?ID=57>

Figure 10: Regions of Eastern Washington that are within 20 miles of existing Staples Office Stores

Areas not covered by a grey circle are further than 20 miles from a Staples Store



If state or local governments were successful at establishing this type of program, Eastern Washington would have a convenient e-waste collection program that relied upon a mixture of product stewardship and traditional services. However, the state may wish to set a goal for a timeframe in which to reach an agreement with retailers, such as two years, after which the agency would pursue other means of establishing a program.

Respondents to the survey also indicated that the hours that recycling services are available to residents must be “convenient.” Again, they did not specify what those hours should be. However, the hours that landfills and transfer stations and recycling depots are open to the public could serve as a model for these factors.

Respondents to the survey also emphasized the need for extensive public education and advertising of collection services in order to make them viable. Residents and businesses would need to be told that the services exist, and educated about what types of electronics each program takes, any fees involved, and the negative environmental effects of disposing electronics instead of using the program to recycle them. This type of education would be necessary no matter which type of collection option is chosen.

The sections below describe the collection and processing options that could be considered to provide this level of service in Eastern Washington.

New Services: Collection

Four primary types of collection services would be viable in Eastern Washington, according to our survey:

- Drop-boxes
- Collection events
- Curbside recycling
- Voluntary take-back programs, including mail-in programs³⁰

DROP-BOXES

As described above, drop-boxes could be placed at landfills, transfer stations, and recycling depots where residents and businesses already bring wastes for disposal and recycling. Boxes also could be placed on the property of major electronics retailers in a product stewardship or public-private partnership arrangement.

Local organizations indicated interest in serving as collection sites for e-waste in the survey conducted for this study. Many landfill and transfer station operators indicated that their facilities would be appropriate places to collect e-waste, as did several non-profits and charities.

COLLECTION EVENTS

Collection events could be held annually or semi-annually to gather obsolete electronics. These events could be specifically for electronics, or added to household hazardous waste or other collection events that local governments already offer. Four local

³⁰Note that manufacturers and retailers were not surveyed for this project. Also, respondents were not prompted to suggest retailers or manufacturers.

governments – Benton County, City of Kennewick, Chelan County, and the City of Richland – have held one collection event each. These governments reported varying levels of satisfaction with these events. The City of Richland was very happy with their event, saying that it went “overwhelmingly well with 470 cars in attendance.” They collected 28,000 pounds of peripheral waste and 633 monitors.

Conversely, Chelan County said the turnout for their event “was not quite what they had hoped for.” One difference between the Chelan event and the Richland event was that the Chelan event charged a fee for disposal but the Richland event was free.

Collection events also are opportunities for local governments to collaborate with each other, with haulers, and with local businesses where such events might be held – or who, in the case of a product stewardship program, would fund such collection events. In our survey, the most commonly cited opportunities to collaborate with others were local governments interested in partnering with each other to hold collection events, and local governments and charities interested in partnering with schools. Additional research should be carried out to determine the true extent of the demand in the schools for refurbished electronics. One local government contact warned that a year or two after receiving donated electronics, schools will find that refurbished electronics no longer meet their needs and will be searching for ways to dispose of them.

Some retailers have implemented product stewardship programs using collection events. Two major retailers, Best Buy and Staples, held computer collection events in 2001 and 2002 respectively. Best Buy held a two-day round-up event that accepted all types of electronics, but charged a fee to accept CRT televisions and monitors. The company plans to hold these events annually in eight to ten markets nationwide.³¹ In partnership with Gifts in Kind International, a non-profit organization, Staples offered consumers who brought computers to its one-time event either \$100 off the price of a new computer at Staples, or \$20 off any purchase of \$100 or more of other products at Staples.³² State and local governments could encourage the expansion of these types of programs in Eastern Washington. (Please see Appendix B for more information about these and other product stewardship initiatives.)

CURBSIDE RECYCLING

Another option for collecting e-waste is to add it to existing curbside recycling programs. This option likely is more viable in urban areas of Eastern Washington, such as the Cities of Spokane, Yakima, or Richland, than in the very rural areas such as Asotin County or Ferry County. Although no local governments offer electronics recycling through curbside programs, one local government representative indicated that curbside recycling would be the most convenient option for e-waste recycling. However, adding e-waste to curbside recycling likely would be very expensive.

VOLUNTARY TAKE-BACK PROGRAMS

This option is a product stewardship program in which manufacturers or retailers voluntarily accept obsolete electronics from consumers. It could take several forms, as described earlier in this chapter. The state could work with retailers in Eastern Washington to set up collection services at stores. Or, manufacturers and retailers could establish programs independently. Some national manufacturers, such as Dell, Hewlett-

³¹ e4 Partners, inc. Best Buy Phase I survey data, Winter 2002.

³² <http://www.eiae.org/whatsnew/news.cfm?ID=57>

Packard, Gateway, IBM, and Sony, already offer voluntary recycling programs (see Appendix B for details).

Several major retailers, including Office Depot, Staples, and Wal-Mart, have stores in Eastern Washington where such programs could occur. However, no retailers were contacted for this study, so little information exists regarding their willingness to engage in a take-back program.

In contrast, survey respondents, such as local government representatives, indicated strong interest in seeing such programs develop. Several representatives stated that the private sector should take responsibility for their products, including changing product designs so that they use less material and little to no toxic materials. Several thought that a fee at the time of purchase would be a good way to encourage (or finance) these types of programs, while others recommended legislation.

HAULING

Although not specifically a collection option, hauling services would be necessary for any collection option implemented. Five of the ten haulers surveyed for this study already provide hauling services for recycling programs, and six said that they could expand their current services to include e-waste. When asked what it would take for them to be interested in expanding their services to include e-waste, waste haulers most frequently said that they would need to make a profit and that they would need more education about where to take the materials and what happens to the materials.

Overall, it seems likely that haulers would be interested in participating in an e-waste collection program if it were economically viable and the procedures were clear.

New Services: Processing

Three options exist for processing e-waste collected in Eastern Washington:

- Develop a processing facility in Eastern Washington;
- Ship the e-waste to existing domestic processors such as those in Seattle, Portland, or the Southwest; or
- Ship the e-waste overseas for processing.

BUILD LOCAL PROCESSING CAPACITY

To the best of our knowledge, there are no businesses in Eastern Washington that disassemble electronics for recycling. Some non-profits, charities, and businesses refurbish electronics for reuse, but most said they couldn't handle more volume than they already do.

Several survey respondents suggested building a processing facility in Eastern Washington, including one respondent who characterized the demand for such processing capacity as a "crying need." This same respondent noted that although building a processing center would be an enormous capital investment, it eventually should pay for itself. It also would have other social benefits, such as job creation and minimization of fossil fuels used for transportation.

SHIP TO DOMESTIC PROCESSORS

Processing facilities for e-waste already exist in the Pacific Northwest, particularly Seattle and Portland. Other processing facilities also exist: for example, the Waste Management website reports that Recycle America owns and operates eight e-scrap recycling centers nationwide, including San Diego, Salt Lake City, and Phoenix. Through these facilities, Waste Management collects and recycles more than thirty thousand tons of e-scrap annually.³³ E-waste from Eastern Washington could be shipped to these facilities for disassembly. The advantages of using domestic processors include investing in the domestic economy, and the knowledge that these processors pay living wages and must comply with stringent environmental regulations.

SHIP TO OVERSEAS PROCESSORS

Processing facilities also exist overseas. However, as the report *Exporting Harm: The High-Tech Trashing of Asia* describes, rather than going to processing facilities, “vast amounts of e-waste material, both hazardous and simply trash, is burned or dumped in the rice fields, irrigation canals, and along waterways.” According to the report, the “open burning, acid baths, and toxic dumping pour pollution into the land, air, and water and exposes the men, women, and children of Asia’s poorer peoples to poison.”³⁴ If e-wastes are sent to overseas processors, only facilities that have been documented to operate in an environmentally friendly manner should be considered.

New Services: Financing Mechanisms

The collection and processing services described above have one aspect in common: they will cost money. This section outlines four ways to pay for these new services:

- Institute a fee at the time of purchase of electronics
- Require manufacturers and retailers to pay for disposal
- Increase taxes
- Charge a fee for users of the new service

FEE AT THE TIME OF PURCHASE

This option is a form of product stewardship in which the user pays the costs of handling the product at the end of its useful life. These types of fees should raise consumer awareness about the environmental effects of their purchases, but they would do little to encourage manufacturers to design products in a more environmentally friendly fashion. Implementing these fees would require federal or state legislation, and agreement upon a responsible party to collect and administer the funds. The fees would need to apply to sales that occur both at brick-and-mortar retail stores and via the Internet. Although data on the percentage of electronics sales in Eastern Washington that occur over the internet were not available, research by TWICE, a market research firm, indicates that nationwide, about 23% of computer sales happen via the internet or mail-order. Several survey respondents said that they thought that a fee at the time of purchase would be an effective way to pay for e-waste reuse and recycling programs.

³³ http://www.wm.com/env_escrapfact.asp

³⁴ <http://www.svtc.org/cleancc/pubs/technotrash.pdf>

REQUIRE MANUFACTURERS OR RETAILERS TO PAY FOR DISPOSAL

Like the option above, this program is another form of product stewardship. In this option, the government could bill manufacturers and/or retailers of electronics for the costs of collecting, transporting, and processing their products, or require them to set up and fund these services themselves. These fees likely would be paid in advance, and would apply to sales at both traditional and virtual stores. The main advantage of these fees is that they would provide a significant incentive to manufacturers to design a more environmentally friendly product, and to retailers to demand such products from manufacturers. Again, this option would require federal or state legislation to be effective.

RAISE TAXES

Local governments could increase the taxes collected that support recycling programs, to pay for the increased level of service. Often these taxes take the form of fees for solid waste programs, such as garbage collection or curbside recycling. Although tax increases are never popular, they may be possible if the costs and benefits of the new programs are explained carefully and if the increases are relatively small.

CHARGE USERS OF THE SERVICES A FEE

Although respondents to our survey discouraged it, the state or local governments could pay for the new programs by charging people who use them. This program is different from the fee at the time of purchase in that it would apply at the end of the product's life, rather than the beginning. The main disadvantage of this fee is psychological: people expect recycling to be free, and are less likely to use a service if they have to pay for it.

AREAS FOR FURTHER RESEARCH

As stated in the introduction to this chapter, the options described above and the conclusions outlined below are based upon limited hard data. We recommend further investigation of at least the following issues:

- Actual amounts of e-waste that households and businesses in Eastern Washington have stockpiled, perhaps through a survey
- The true demand for refurbished electronics among school districts
- Costs and benefits of building a new processing facility in Eastern Washington
- Feasibility of raising taxes to cover the new services
- Willingness of retailers in Eastern Washington to participate in product stewardship programs
- Willingness of manufacturers to participate in voluntary take-back programs
- Feasibility of banning disposal of CRTs
- The public's demand and desire for services, including 1) what type of services are desired; 2) willingness to pay for them; 3) definition of "convenience"; and 4) current behavior with obsolete equipment.

CONCLUSIONS

This section presents the consultants' recommendations for new services for e-waste recycling in Eastern Washington, based upon the foregoing assessment. When considering these conclusions, it is important to remember this study's limitations: very little hard data exists about generation and stockpiling of e-waste, and the survey conducted for this study was not designed to be statistically significant. However, the consultant team believes that the following recommendations are reasonable given these constraints, and may be useful to the state as it considers implementing e-waste services in Eastern Washington.

- As described above, the team's first recommendation is that the state and its partners not wait for the NEPSI process to conclude before planning for new e-waste collection and processing services. Such advance planning would position the state well for participation in any program that NEPSI recommends, or to institute one if NEPSI fails.
- Even if NEPSI does not result in a national product stewardship program, the state should pursue local product stewardship programs. Many local government contacts indicated interest in and support for developing such programs.
- The consultant team recommends designing a collection program that employs a mix of drop-boxes and collection events. Residents of Eastern Washington should find these services convenient, particularly if they are free, and if the drop-boxes are located at transfer stations, landfills, recycling centers, and major retailers. Given that many of the landfill and transfer station operators and charities indicated that they were willing to serve as collection points, and haulers were cautiously optimistic about expanding their services to include e-waste, opportunities exist to partner with local governments and private businesses to provide these services. This program could be accomplished through product stewardship initiatives, or through traditional mechanisms.
- If the state wishes to pursue product stewardship in Eastern Washington without legislation, one option is to work with one or more major retailers to establish collection sites on their property. Once the distribution of these collection sites is known, the state can work with local government partners to establish other collection services in areas that the retailer collection sites do not serve. However, it is important to note that retailers and manufacturers were not surveyed for this study, so it is not possible to estimate how willing they may be to participate in product stewardship programs. To the best of our knowledge, no electronics manufacturers are located in Eastern Washington, but a wide variety of retailers are.
- Also, the consultant team recommends further investigation of the costs and benefits involved in building a processing facility in Eastern Washington. In the meantime, e-waste should be sent to domestic processors. Using domestic processors will stimulate the economy and assuage concerns about the environmental effects of recycling e-waste overseas.
- We recommend that the state and its partners pursue a variety of financing mechanisms for e-waste recycling. Through Washington's ongoing participation in the NEPSI and WEPSI processes, the state can continue to lobby for product

stewardship programs to finance e-waste recycling, such as fees at the time of purchase or requiring manufacturers or retailers to pay for recycling.

- It may be appropriate to develop state legislation requiring advance disposal fees, for use in case NEPSI fails or to fill the gap between the present and when a national system is adopted. The Product Stewardship Institute has created model legislation that Washington could adapt for its purposes.³⁵ Many local solid waste officials would support product stewardship initiatives: many of the local solid waste contacts surveyed said that they were interested in seeing product stewardship programs develop, particularly those that call for advance disposal fees.
- At the same time, the state could investigate the feasibility of working with local governments to raise fees to cover e-waste services, or charging fees at the time of disposal. The latter program likely is more feasible, given the current political climate.

In summary, interest in diverting e-waste from the landfill is growing, both nationally and in Eastern Washington specifically. Although this report is based upon limited hard information and anecdotal evidence, it identifies several promising trends, including the following:

- Many Eastern Washington local governments and businesses are interested in providing e-waste reuse and recycling services to citizens, and
- The current momentum behind e-waste product stewardship has the potential to shift the traditional paradigm of local governments bearing all or most of the costs of recycling and disposal of obsolete products.

Armed with the information in this report, the state can investigate further the many options for developing a successful e-waste reuse and recycling systems in Eastern Washington.

³⁵ <http://www.productstewardshipinstitute.org/policies.htm>

Works Cited

- California Integrated Waste Management Board. "Selected E-Waste Diversion in California: A Baseline Study." November 2001.
- Cascadia Consulting Group, *1998/1999 Residential Waste Stream Composition Study: Final Report*. Seattle: Seattle Public Utilities, Feb. 2000.
- Computer Industry Almanac, Inc. "PCs-In-Use Surpassed 600M. Over 45% of Worldwide PCs Are in Homes." Press Release Issued March 11, 2002.
- e4 Partners, inc. Best Buy Phase I survey data, Winter 2002.
- E-Scrap News, Volume 2, No.12, December 2002. Page 1.
- Electronic Industries Alliance. "Staples hosts computer trade-in event in stores nationwide February 17-18." EIA Environment Consumer Education Initiative, <http://www.eiae.org/whatsnew/news.cfm?ID=57>
- Environmental Protection Agency. *Desktop Computer Displays: A Life-Cycle Assessment*. EPA Publication 744-R-01-004a. December 2001.
- ETForecasts. "Worldwide PC Forecast 1990-2006: A Perspective and a top-down view of the PC Industry — Past, Present and Future Trends" www.etforecasts.com/products/1.1.
- Franklin Associates. *Municipal Solid Waste in the United States: 2000 Facts and Figures*: Washington, DC: Environmental Protection Agency Office of Solid Waste and Emergency Response, June 2002.
- Lohr, Steve. "The web hasn't replaced the storefront quite yet." *New York Times (east coast late edition)* October 3, 1999 p. 4.
- Mathews, H. Scott et al. *Disposition and End-of-Life for Personal Computers*. Carnegie Mellon University Green Design Initiative Technical Report #97-10, 1997.
- Massachusetts Department of Environmental Protection. *Electronics re-use and recycling infrastructure development in Massachusetts*. September 2000.
- National Safety Council. *Electronic Product Recovery and Recycling Baseline Report: Recycling of Select Electronic Products in the United States*. Washington, DC. May 1999.
- O'Connell, K.A. "Computing the Damage." *Waste Age*, Volume 33, No. 10, October 2002, pp.48-57.
- Olenick, Doug. "Consumer Direct PC Sales Surge." *This Week in Consumer Electronics* vol. 15:15, 2000, p 26.
- Olenick, Doug. "PC Product Sales dip 2.2% in 2001." *This Week in Consumer Electronics* vol. 17:15, 2002, p 28.
- Product Stewardship Institute. "Principles of Product Stewardship." <http://www.productstewardshipinstitute.org/policies.htm>
- Recycle America. "Why E-Scrap?" http://www.wm.com/env_escrapfact.asp

Stanford Resources. "Stanford Resources' Experts See Continued Growth in the TV Market with New Technologies Beginning to Erode Direct View CRT Market Share." Press Release issued January 8, 2002.
www.stanfordresources.com/press/020108.html.

Stanford Resources. "Stanford Resources Expert Forecasts Major Shifts in CRT Monitor Marketplace." Press Release issued October 2, 2001.
www.stanfordresources.com/press/011002.html.

Stanford Resources. "Stanford Resources Forecasts LCD Demand to be Driven by Desktop Monitor Application." Press Release issued June 4, 2001.
www.stanfordresources.com/press/010604.html.

Students Recycling Used Technology (StRUT). <http://www.strut.org/>

TWICE PC Retail Registry, cited in Olenick (2002), above.

Washington State Department of Ecology's Interim Enforcement Policy for Conditional Exclusion of Cathode Ray Tubes and Related Electronic Wastes.
<http://www.ecy.wa.gov/biblio/0204017.html>

Wilt, Catherine. Personal communication to Laura Blackmore, December 4, 2002, Seattle, WA.

Appendix A: Calculation and Projection Methodology

COMPUTER OWNERSHIP STATISTICS

Each month, the US Census Bureau conducts the Current Population Survey (CPS), a survey of about 50,000 households across the U.S. The survey has been conducted for more than 50 years, and is the primary source of information on the labor force characteristics of the U.S. population.

In September 2001, the CPS included the Computer and Internet Use Supplement. This survey supplement queried households about their computer and internet use and purchasing patterns. As of this report, the Census Bureau has only reported results on a national level. However, they have made available the raw survey data on a web site, <http://www.bls.census.gov/cps/computer/2001/suppovrw.htm>.

Cascadia Consulting obtained this data to estimate computer ownership patterns in Eastern Washington. This process involved setting up a Microsoft Access Database to interpret and query the data. Although the specific location of each survey respondent was not detailed, the data did contain several levels of geography that enabled us to assemble data relevant to Eastern Washington. Cascadia first filtered the data to include only respondents from Washington State, and then selectively removed populations from Western Washington, which were coded by metropolitan statistical area (MSA) and county. The result was a dataset of 671 survey responses from which to estimate computer ownership patterns. However, because some responses were not coded as belonging to a particular metropolitan area or county, a small number of responses from rural Western Washington are likely included in the “Eastern Washington” dataset we produced. This was an unavoidable artifact of using this raw data, and likely introduces some small uncertainty to estimated computer ownership patterns in Eastern Washington.

Finally, it is important to note that the only metropolitan statistical area in Eastern Washington that was coded in the dataset was Spokane, although according to the Census Bureau the Yakima and Tri-Cities areas are also classified as metropolitan statistical areas. Consequently, we are only able to estimate computer ownership patterns for Spokane and the remainder of Eastern Washington, but no more specific geographies.

Other metropolitan areas in Eastern Washington (including the Yakima and the Tri-Cities areas) may show similar trends, but in this study they are included in the “remainder of Eastern Washington” category because of the limitations of the raw data.

STOCKPILING

Little information is presently available to directly estimate the quantity of electronic equipment currently stored (and not used) by Eastern Washington residents. However, a recent survey in California found the following:³⁶

Number of televisions in storage and no longer being used	
	Pct. of Respondents
None	81.5%
1 television	13.0%
2 televisions	3.9%
3 or more televisions	1.6%
Total	100%

Number of computer monitors in storage and no longer being used	
	Pct. of Respondents
None	80.6%
1 monitor	13.9%
2 monitors	2.7%
3+ monitors	2.8%
Total	100%

Estimates of current e-waste stockpiling were calculated by applying the above totals to the number of households presently in Eastern Washington.

³⁶ California Integrated Waste Management Board. "Selected E-Waste Diversion in California: A Baseline Study." November 2001.

FUTURE GENERATION

RESIDENTIAL

Projections for **computer e-waste** generated by residents were calculated using the following approach:

1. **Project the number of households in Eastern Washington through 2010.** This was accomplished using Census data combined with growth projections by Washington State Office of Financial Management.
2. **Gather, process, and analyze survey information from Eastern Washington to determine computer ownership and purchase patterns.** The U.S. Census Bureau's Current Population Survey Supplement conducted in September 2001 provided the raw data for this analysis.
3. **Use the survey information to estimate computer purchases by year between 1991 and 2001.** We then assumed sales growth rates (by consulting industry web sites) to estimate the sales through 2010.
4. **Gather information about the relative proportion of different types of computers and monitors.** This information was obtained by studies by Stanford Resources.
5. **Make assumptions about the average useful life of computer equipment.** These assumptions were based on a review of industry web sites and other e-waste studies.
6. **Use the above calculations to estimate the annual generation of obsolete computer equipment.** This step of the analysis was patterned after a model developed by Carnegie Mellon University in Pennsylvania.

Calculations for **television e-waste** were calculated using a slightly simplified approach:

1. **Estimate how many televisions will be in use in each year between 2001 and 2010.** This involved combining household projections (discussed above) with television ownership data compiled from the Massachusetts e-waste study, which found that 99% of households have at least one TV, with the average household having an estimated 2.55 televisions.³⁷ Since televisions are ubiquitous, the findings in the Massachusetts study are assumed to be reasonably accurate in Eastern Washington.
2. **Assume an average lifespan for televisions.** Other studies report ranges between 6 and 30 years. For this study, we use a planning estimate used by the Federal Government of 8 years.
3. **Calculate the number of obsolete televisions generated each year by** assuming that in any given year, the number of televisions that become obsolete is the total number divided by their average lifespan. In other words, if the average lifespan of a TV is 8 years, then each year 1/8 of all televisions in use will become obsolete.

³⁷ Massachusetts Department of Environmental Protection. "Electronics re-use and recycling infrastructure development in Massachusetts." September 2000.

The following data elements and sources were used in these projections.

Data Element	Source
Number of Households	Washington OFM and US Census Bureau ³⁸
Computer Ownership Data	US Census Bureau Current Population Survey ³⁹
Technology Trends	Stanford Resources ⁴⁰
Television Ownership Data	Massachusetts Study ⁴¹
Computer Sales Growth	Computer Industry Almanac, Inc. ⁴²
Useful life of CRT monitor	National Safety Council ⁴³
Useful life of flat-panel monitor	Assumed to be the same as CRT, per an EPA lifecycle comparison ⁴⁴
Useful life of CPU	National Safety Council ⁴⁵
Useful life of TV	White House Office of Management and Budget
Weights of CRTs and CPUs	California Integrated Waste Management Board
Weights of laptop and flat-panel computers	Industry web sites, detailed in following table
Average weight of televisions	California and Massachusetts E-Waste studies

³⁸ www.ofm.wa.gov and www.census.gov

³⁹ <http://www.bls.census.gov/cps/computer/2001/suppovrw.htm>

⁴⁰ www.stanfordresources.com/press/011002.html and www.stanfordresources.com/press/010604.html.

⁴¹ Massachusetts Department of Environmental Protection. "Electronics re-use and recycling infrastructure development in Massachusetts." September 2000.

⁴² Computer Industry Almanac, Inc. "PCs-In-Use Surpassed 600M. Over 45% of Worldwide PCs Are in Homes." Press Release Issued March 11, 2002.

⁴³ National Safety Council. Electronic Product Recovery and Recycling Baseline Report: Recycling of Select Electronic Products in the United States. Washington, DC. May 1999.

⁴⁴ Socolof, Maria et al. *Desktop Computer Displays: A Life-Cycle Assessment*. Environmental Protection Agency. Publication 744-R-01-004a. December 2001, p. 2-37.

⁴⁵ National Safety Council. Electronic Product Recovery and Recycling Baseline Report: Recycling of Select Electronic Products in the United States. Washington, DC. May 1999.

The following weights were assumed in converting unit-based e-waste projections to weight.

Item	Avg weight, in pounds	Source
Central Processing Unit (CPU)	26	California Integrated Waste Management Board
Cathode Ray Tube (CRT) Monitor	30	California Integrated Waste Management Board
Television	50	California and Massachusetts E-Waste Studies
Laptop computer	7	Approximate average weight of standard Dell and Gateway laptop computers ⁴⁶
Flat-panel monitor	10	Approximate average weight of several models detailed on Gateway website, which lists product weights for a wide range of makes and models. ⁴⁷

The following graphic shows the basic data elements, and lists some assumptions, notes, and limitations.

⁴⁶ Product weights listed on www.dell.com and www.gateway.com. The standard laptop from both manufacturers weighs between 6.8 and 7.5 pounds. Lightweight models range from 3 – 6 pounds, while fully loaded models intended to replace a desktop computer weigh 8 – 9 pounds.

⁴⁷ www.gateway.com. Gateway lists product specifications for a wide variety of models made by Gateway, ViewSonic, NEC, Sony, and others. In general, 15" flat-panel monitors weigh 7 – 10 lbs; 17" flat-panel monitors weigh 10 – 15 lbs; and 18" and larger monitors weigh 15 – 25 lbs. We assume an average weight of 10 pounds for this study.

Model Inputs for Residential E-Waste Projections – Annual Generation

Note: White cells are expected inputs, yellow and grey cells are assumptions based on those inputs.

Model Inputs

Demographics

Households	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
	724,330	715,997	707,664	699,331	690,998	682,665	674,332	665,999	657,666	649,333	641,000

Electronics Ownership

Data current as of: (Year)

Computer Ownership of households

TV Ownership of households

Note: Computer ownership data is from the US Census Bureau's Current Population Survey Supplement, conducted in September of 2001.

How many computers?

1
 2
 3+
 =
 (This is: 1.25 per hh)

How many TVs?

1
 2
 3
 4
 5
 6+
 =
 (This is: 2.55 per hh)

When were computers purchased?

	Newest	Second	Third
first 8 months of: 2001	15%	7%	0%
entire year of: 2000	26%	9%	0%
1999	22%	15%	2%
1998	14%	19%	4%
1997	8%	19%	9%
1996	4%	15%	15%
1995	3%	9%	19%
1994	2%	4%	19%
1993	1%	2%	15%
1992	1%	0%	9%
1991	5%	0%	7%
pre-	100%	100%	100%
Avg age:	3.1	4.0	7.0 years

Sales and useful life assumptions

Annual computer sales growth

2010	4%
2009	4%
2008	4%
2007	5%
2006	5%
2005	5%
2004	5%
2003	6%
2002	6%
2001	6%

Avg. useful life of CRT monitor years

Avg. useful life of flat-panel monitor years

Avg. useful life of CPU years

Avg. useful life of laptop/mobile years

Avg. useful life of TV years

General Assumptions:

- The average lifespan of computers, monitors, and televisions remains relatively constant.
 - The average lifespans of computer equipment is assumed based on a review of various industry web-based resources, as well as other e-waste studies, especially the baseline study conducted by the National Safety Council (NSC). These figures are assumed to be averages. Note in particular that the NSC predicts that the useful life of new PCs will decline from about 3 years in 2000 to 2 years in 2006, when it will level off. In this study, we make the conservative assumption that the average useful life of a CPU is 3 years.
 - Households with more than one computer purchased their computers in the same interval as computers become "obsolete" in other words, every 3 years.
 - Annual sales growth is not intended to be accurate on a year-by-year basis. Assumptions are based on near-term projections of 6%, according to the Computer Industry Almanac, gradually declining as greater market penetration is achieved.
- #### Other Notes & Limitations:
- This model does not attempt to estimate stockpiling of e-waste, only annual generation. Obsolete items may be disposed, stored, donated or sold, or recycled.
 - The model does not track computers that became obsolete before 2001. This means that computers that were stockpiled before 2001, and are still stockpiled, are not included in these projections. The model tracks only the annual generation of electronics that become obsolete in each year.
 - The Model assumes all computers purchased before 1992 were purchased in 1991.

COMMERCIAL (SMALL QUANTITY GENERATOR)

Projections for e-waste generation from small quantity generators involved a somewhat different methodology. Because extensive survey or sales information was not available, the consultant took the following approach:

- 1. Estimate how many computers are *in use* by SQGs in each year between 1995 and 2010.** This involved developing estimates of how many people were employed in each industry sector (by two-digit SIC codes) between 1995 and 2010, and then using data on the number of computers per employee for each industry group (or per farm, for the agriculture sector), assuming *that this ratio is virtually constant over the time period*. Although this last assumption is somewhat limiting, sufficient information was not available to document changing use of computers within each industry.
- 2. Assume average lifespans for computer monitors and CPUs, as well as laptops.** This type of information was gathered by surveying industry web sites and other e-waste studies.
- 3. Assume that the relative proportion of flat-panel monitors, laptops, and CRT monitors is the same as it is for residential computers.**
- 4. Calculate the number of obsolete computers generated each year** by assuming that in any given year, the number of computers that become obsolete is the total number of computers divided by the average lifespan of those computers. In other words, if the average lifespan of a computer monitor is 4 years, then each year 1/4 of all computer monitors in use will become obsolete.

The following data sources were used to accomplish these projections.

Data Element	Source
Number of employees per industry group	1997 Economic Census
Number of farms	USDA National Agricultural Statistics Service
Industry growth rates	Washington OFM
Number of computers per employee, by industry group	U.S. Energy Information Administration (EIA) – detailed information in following table
Useful life of computer equipment	Same as for residential projections, detailed above

The following data and assumptions were made regarding the number of computers in use per employee, for each industry group.

Industry Group	Avg. Computers per employee	Source
Wholesale trade	0.419	U.S. EIA
Retail trade	0.313	U.S. EIA
Real estate & rental & leasing	0.954	U.S. EIA
Professional, scientific, & technical services	0.954	U.S. EIA
Administrative & support services	0.954	U.S. EIA
Arts, entertainment, & recreation	0.326	U.S. EIA
Accommodation	0.800	U.S. EIA
Food service	0.138	U.S. EIA
Other services (except public administration)	0.326	U.S. EIA
Agriculture	0.5 <i>per farm</i>	USDA-NASS ⁴⁸

⁴⁸ National Agricultural Statistics Service. "Farm Computer Usage and Ownership." July 30,2001. <http://usda.mannlib.cornell.edu/reports/nassr/other/computer/>

Appendix B: Additional Product Stewardship Information

PRODUCT STEWARDSHIP INITIATIVES

This appendix provides brief descriptions of national and regional product stewardship initiatives and programs that are taking shape in the United States. It is intended to provide background information as a context for the conclusions drawn in section 4 of this report about the opportunities for product stewardship programs in Eastern Washington. It is not an exhaustive list of all product stewardship programs or initiatives.

The Northwest Product Stewardship Council defines product stewardship as follows:

Product stewardship means that whomever designs, makes, sells, or uses a product takes responsibility for minimizing its impact on the environment. This responsibility spans the product's life cycle – from selection of raw materials to design and production processes to its use and disposal.⁴⁹

This section describes national, regional, and local product stewardship initiatives, as well as voluntary programs that manufacturers and retailers have implemented.

NEPSI and WEPSI

Currently, two major product stewardship initiatives that affect Eastern Washington are underway: the National Electronics Product Stewardship Initiative (NEPSI) and the Western Electronics Product Stewardship Initiative (WEPSI). Both are multi-stakeholder efforts to develop product stewardship programs for electronics, one at the national level and one at the regional level. The WEPSI process also provides an opportunity for western stakeholders to submit input to the NEPSI effort. Both processes have focused on CRTs, CPUs, and TVs.

The NEPSI project started in June 2001, and was to have been completed in September 2002. However, the November 2002 issue of *E-Scrap News*⁵⁰ announced that a subcommittee of the NEPSI group has been working to develop a stewardship recommendation that it will deliver to the full NEPSI committee in early 2003. The December 2002 issue of *E-Scrap News*⁵¹ reported that the small group is considering the following issues:

- Institute a front-end fee. Although this recommendation is still under negotiation, members of the small group report that they are considering establishing a two-phased system. In the first phase, consumers would pay an advanced recycling fee (ARF) on new computers, monitors, and TVs that would fund collection and recycling of stockpiled electronics. Once stockpiles are reduced or eliminated, the fee would sunset, and “industry would internalize the cost of a recovery system in

⁴⁹ As reported on the WEPSI website at <http://www.recyclingadvocates.org/wepsi/ps.htm>

⁵⁰ Volume 2, No. 11, page 1

⁵¹ Volume 2, No. 12, page 1

the value of new products.” The article does not provide details on how this internalization would occur.

- Create a recovery system. Negotiators are discussing a scenario in which industry would fund a certain level of collection service, transportation, and processing costs. Local governments, in turn, would pay for advertising the service and any additional enhancements desired.
- Lobby for federal legislation. In order for this system to work, federal legislation is required. However, negotiators are concerned that the public will view the front-end fee as a new tax, which might spell the political end of any NEPSI proposal.

According to Catherine Wilt, staff to NEPSI, the full NEPSI group will begin considering the small group’s draft recommendations in late February 2003, and likely will take several meetings to come to an agreement. Once the group agrees upon a model, it will produce a Memorandum of Agreement or similar document that will describe a path for implementing this model, including Congressional action⁵².

The November *E-Scrap News* article also states that if the NEPSI effort does not produce agreement on a national electronics product stewardship program, several states would likely enact legislation to establish their own programs, and voluntary recovery partnerships between industry members and individual states would begin.

The WEPSI project began in early 2001, and included stakeholders from Washington, Oregon, Nevada, Idaho, California, Arizona, Alaska and Hawaii. Because the WEPSI area is so large, it split into two areas, WEPSI-Northwest and WEPSI-Southwest. Washington is in WEPSI-Northwest, along with Oregon, Alaska, and Idaho.

In August 2002, WEPSI-Northwest produced an Action Plan in conjunction with the stakeholders of WEPSI-Southwest. This Action Plan presents thirty-nine action items organized around three primary themes:

- Ensure an adequate e-scrap infrastructure in the Northwest;
- Develop a method to assess the effect of design on end-of-life management and facilitate communications between end-of-life managers and product designers; and
- Continue and expand engagement of Northwest stakeholders in implementation of WEPSI and NEPSI outcomes as appropriate.

Although the Action Plan identifies a process for initiating implementation of these actions, it also notes that funding is not available for most of the action items.

The Northwest Product Stewardship Council

The Northwest Product Stewardship Council is a group of businesses, governments, and non-profit organizations located in the Pacific Northwest that provides the following services:

- Provide: networking opportunities and information sharing
- Research: programs and policies

⁵² Catherine Wilt, personal communication to Laura Blackmore, December 4, 2002, Seattle, WA.

- Organize: educational events, publications, and forum for discussion and action
- Demonstrate: pilot programs that promote product stewardship
- Understand: options, varied approaches and viewpoints
- Coordinate: projects and partners
- Train: through technical assistance and outreach⁵³

For example, the Council has developed a *Guide to Environmentally Preferable Computer Purchasing*, which shows buyers how to include specifications for product stewardship in their bids, and summarized the myriad of environmental labeling programs for electronics in *Eco-Labels and Product Certifications for Computers, Monitors, and Printers*.⁵⁴ The Council also works on other products besides e-waste, including apparel, medical wastes, mercury, and tires.⁵⁵

Snohomish County's Take It Back Network

One local product stewardship initiative, Snohomish County's Take It Back Network, could provide a model for other programs. This Western Washington county recently banned disposal of CRTs and circuit boards from all sources, and instituted this network as an alternative to disposal. This program is a voluntary partnership between the Snohomish County government and a wide variety of electronics recyclers. The Snohomish County Solid Waste Division provides information about recycling facilities and technical assistance to network partners, and existing electronics recyclers provide recycling services to residents and businesses. Recyclers are allowed to charge fees, which are not set by the Snohomish County government.

Programs such as the Snohomish County Take It Back program require three conditions: a government agency with the staff and funding to set up and maintain such a network, a ban on disposal, and existing recycling capacity within a convenient driving distance of residents and businesses. These conditions currently are difficult to meet in Eastern Washington.

Manufacturer Programs

A number of manufacturers are beginning to offer reuse and recycling programs, and to begin to design for the environment. A selection of these programs is described below; for a more comprehensive list of industry initiatives, please see <http://www.epa.gov/epr/products/eindust.html>.

Dell Computers' website⁵⁶ describes four ways to reuse or recycle old Dell computers: customers can trade in old computers for credit toward a new Dell computer, ship old computers back to Dell for recycling, sell used computers on an online auction site, or donate used computers through a partnership between Dell and the National Cristina Foundation.

Hewlett-Packard's website⁵⁷ allows customers in the contiguous United States to arrange for pick-up of used computers. The company charges for the service. Hewlett-

⁵³ <http://www.productstewardship.net/about.html>

⁵⁴ <http://www.productstewardship.net/productsElectronics.html>

⁵⁵ <http://www.productstewardship.net/products.html>

⁵⁶ http://www.dell.com/us/en/dhs/topics/segtopic_dell_exchange.htm

⁵⁷ <http://www.hp.com/hpinfo/community/environment/recycle/hardware.htm>

Packard donates computers that are still usable, disassembles those that aren't, and finds manufacturers who can use the steel, copper, and other materials that result. The website states that Hewlett-Packard recycles over 4 million pounds of computer-related items per month worldwide.

Likewise, IBM offers a similar service in which customers can ship unwanted computers to Envirocycle, a recycling center, for \$29.99, which includes shipping costs.⁵⁸ Envirocycle either disassembles the old computers or donates the reusable ones to Gifts in Kind International. According to the website, IBM recycled over 120 million pounds of machines and parts in 1999.

Sony partnered with the State of Minnesota to provide a free statewide take-back program in 2000, and began a similar program in Connecticut in 2001. According to its website, Sony's goal is to have a nationwide program operating by 2005.⁵⁹

Gateway offers a rebate of up to \$50 on new Gateway computers for customers who recycle or donate their old computer.⁶⁰ However, it is up to the customer to find a charity or recycler who will take the old computer.

Retailer Programs

The Electronics Industry Alliance website reports that during Presidents Day weekend, 2002, office-supply retailer Staples held a nationwide two-day computer collection event at its stores in partnership with Gifts in Kind International, a non-profit organization. Staples offered consumers who brought computers to the event either \$100 off the price of a new computer at Staples, or \$20 off any purchase of \$100 or more of other products at Staples.⁶¹

Another example of a successful retailer round-up event is the program initiated by Best Buy in 2001. Best Buy plans to hold annual e-waste recycling events in eight to ten markets across the country. The two-day round-up events accept all types of electronics, but charge a fee to accept CRT televisions and monitors. Results from the first phase of their study indicate fair participation (over 1% of local residents attended) and high consumer satisfaction (nearly 80% "very satisfied").⁶² However, the only Best Buy store in Eastern Washington is in the Tri-Cities area, and it was not a participant in Best Buy's national recycling program. (See Appendix D for a map of big-box electronics chains in Eastern Washington).

⁵⁸ <http://www.ibm.com/news/2000/11/142.phtml>

⁵⁹ http://news.sel.sony.com/corporateinfo/environmental_affairs/

⁶⁰ <http://www.gateway.com/home/programs/recycle.shtml>

⁶¹ <http://www.eiae.org/whatsnew/news.cfm?ID=57>

⁶² e4 Partners, inc. Best Buy Phase I survey data, Winter 2002.

Appendix C: Additional Maps of Electronics Sales Outlets and Facilities

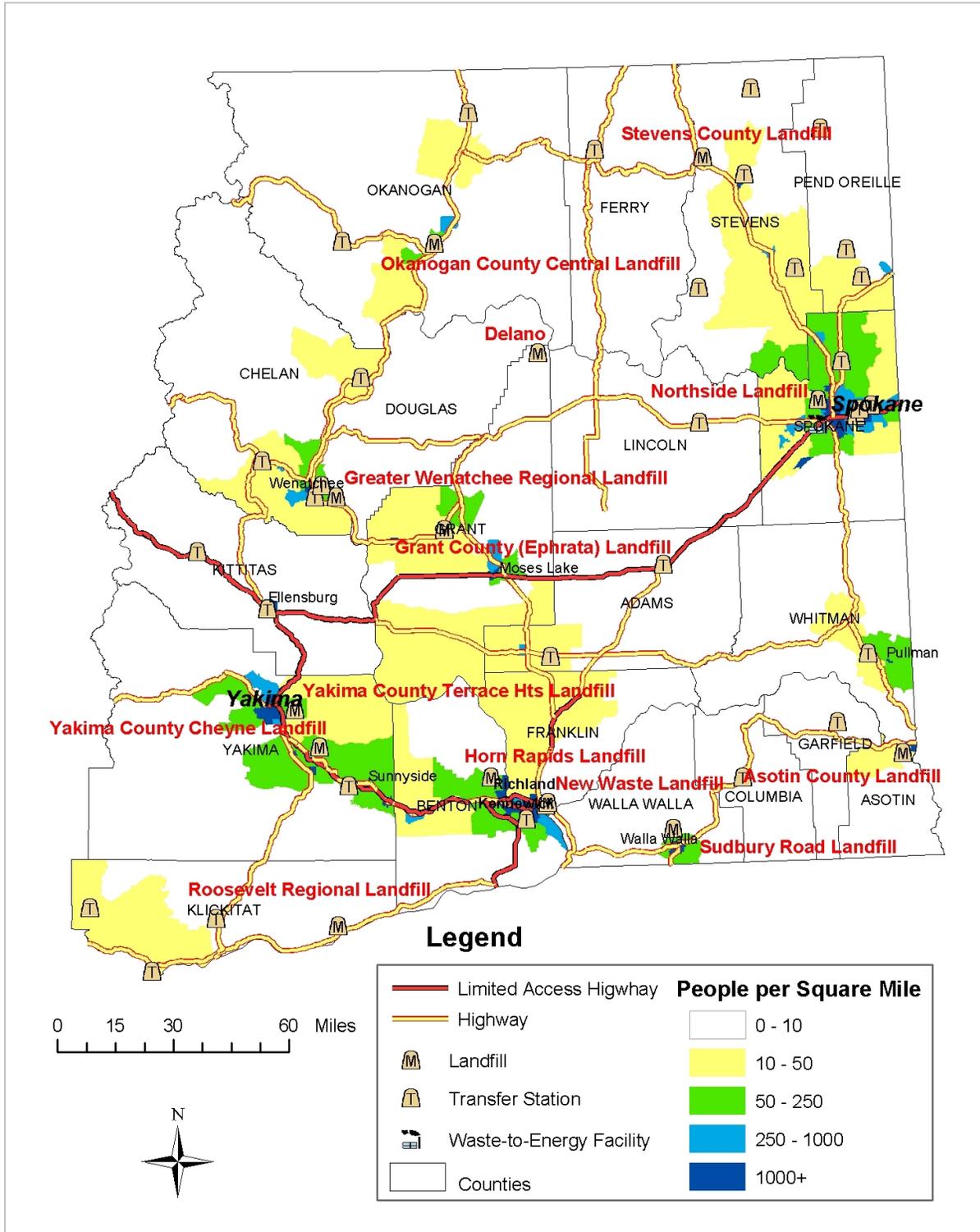
The following maps show the location of the following facilities and retail stores in Eastern Washington, for the purposes of identifying potential partners and locations for product stewardship and electronics collection programs:

- **Landfills and Transfer Stations**, as recorded in Ecology's 2002 solid waste facility database;
- **Big Box Electronics Chains** (Best Buy, Magnolia Hi-Fi, Good Guys TV and Video, and Circuit City), as recorded in Reference USA, an on-line database of business locations and data;
- **Big Box Computer Chains** (CompUSA and Computer Renaissance) as recorded in Reference USA, an on-line database of business locations and data;
- **Big Box Office Store Chains** (Office Max, Office Depot, and Staples), as recorded in Reference USA, an on-line database of business locations and data;
- **Big Box Mass Merchant Chains** (Wal-Mart, Kmart, Target, and Costco), as recorded in Reference USA, an on-line database of business locations and data; and
- **Thrift Store and Non-Profit Computer Recovery Stores** (Goodwill, Salvation Army, St. Vincent de Paul, Reca Foundation) as recorded in Reference USA, an on-line database of business locations and data, and the on-line Qwest directory.

The locations of these facilities are shown on the following maps; population density (by census tract) is also shown, to display the location of the various facilities relative to population centers.

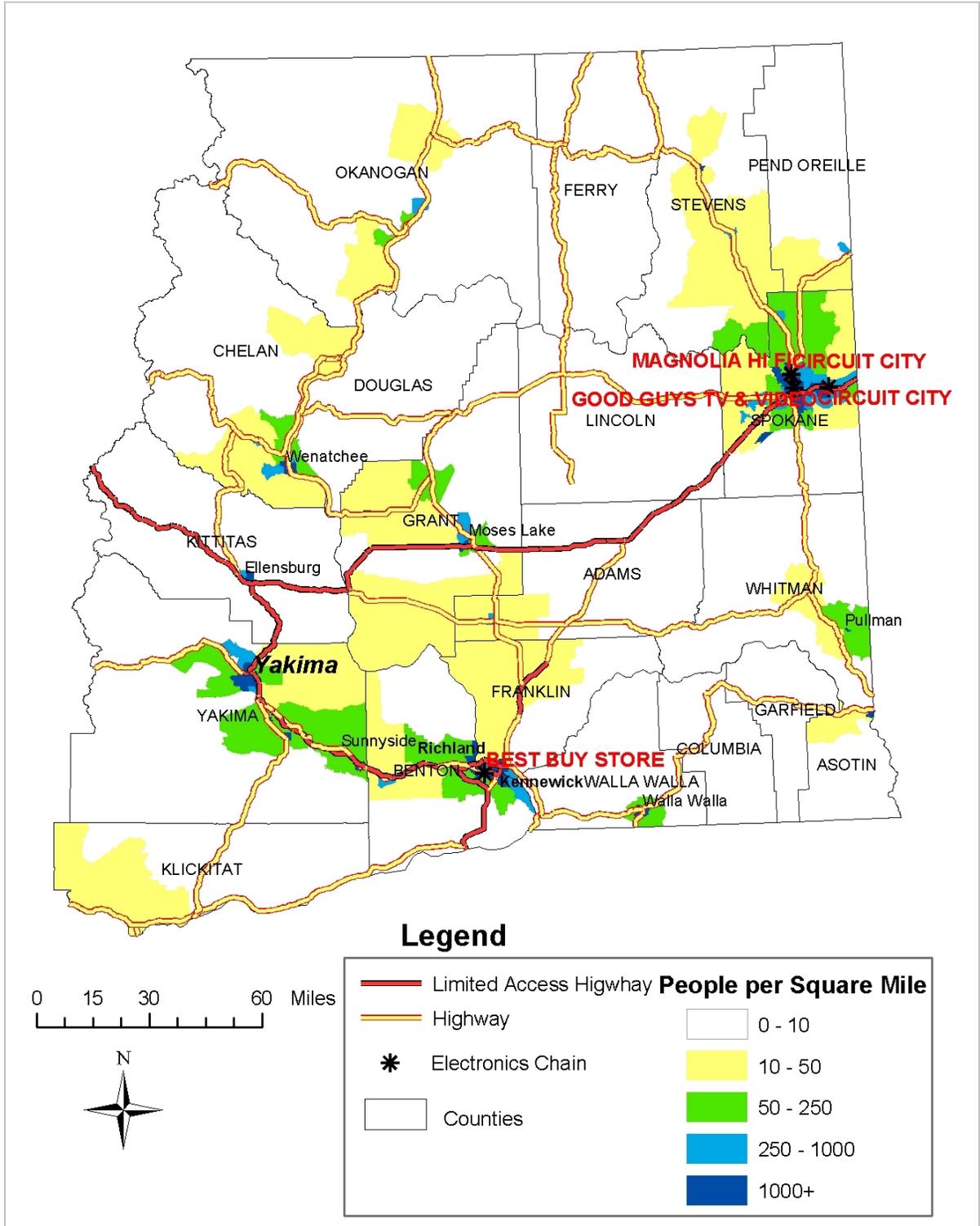
LANDFILLS AND TRANSFER STATIONS IN EASTERN WASHINGTON

NOVEMBER 2002



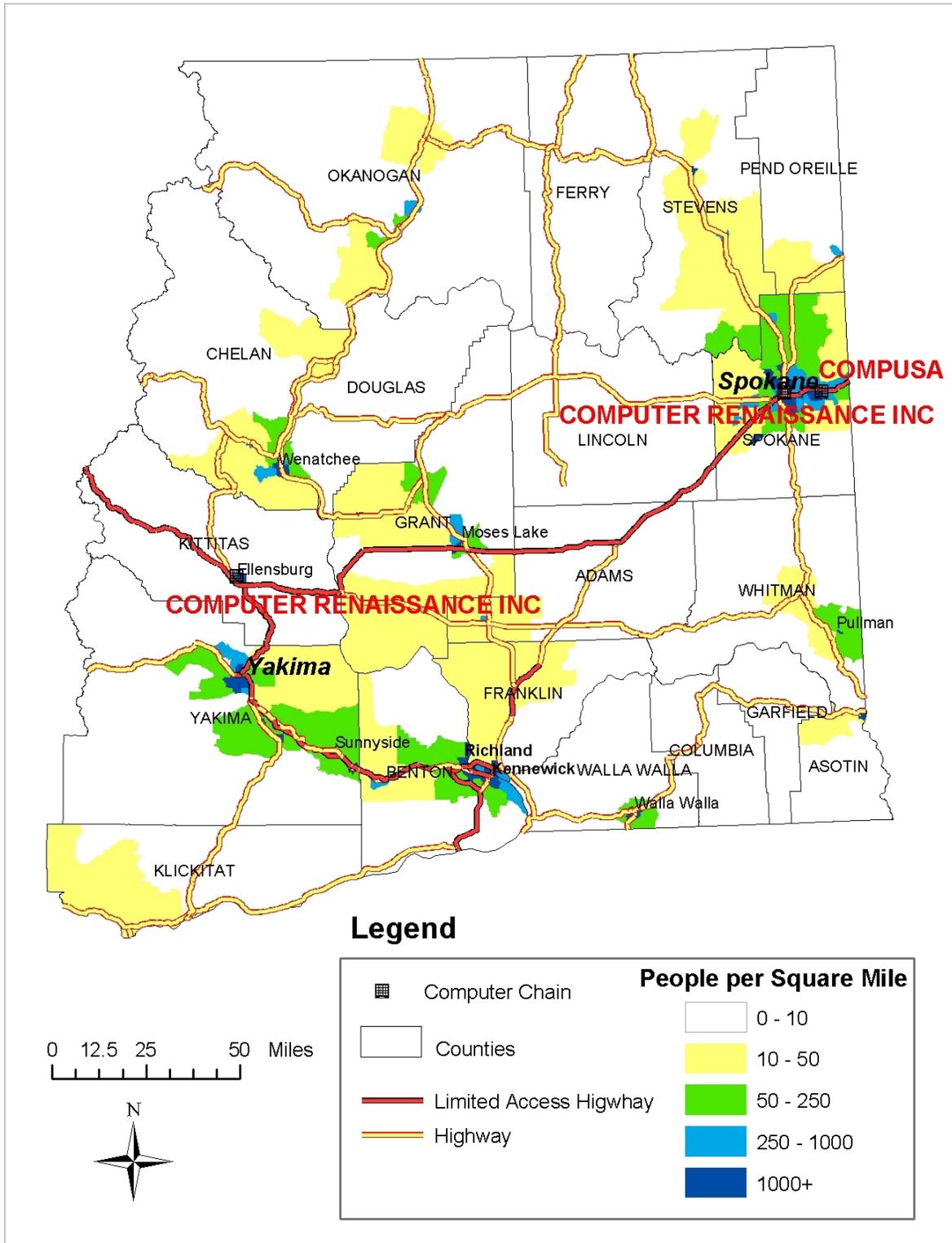
BIG-BOX ELECTRONICS CHAINS IN EASTERN WASHINGTON

NOVEMBER 2002



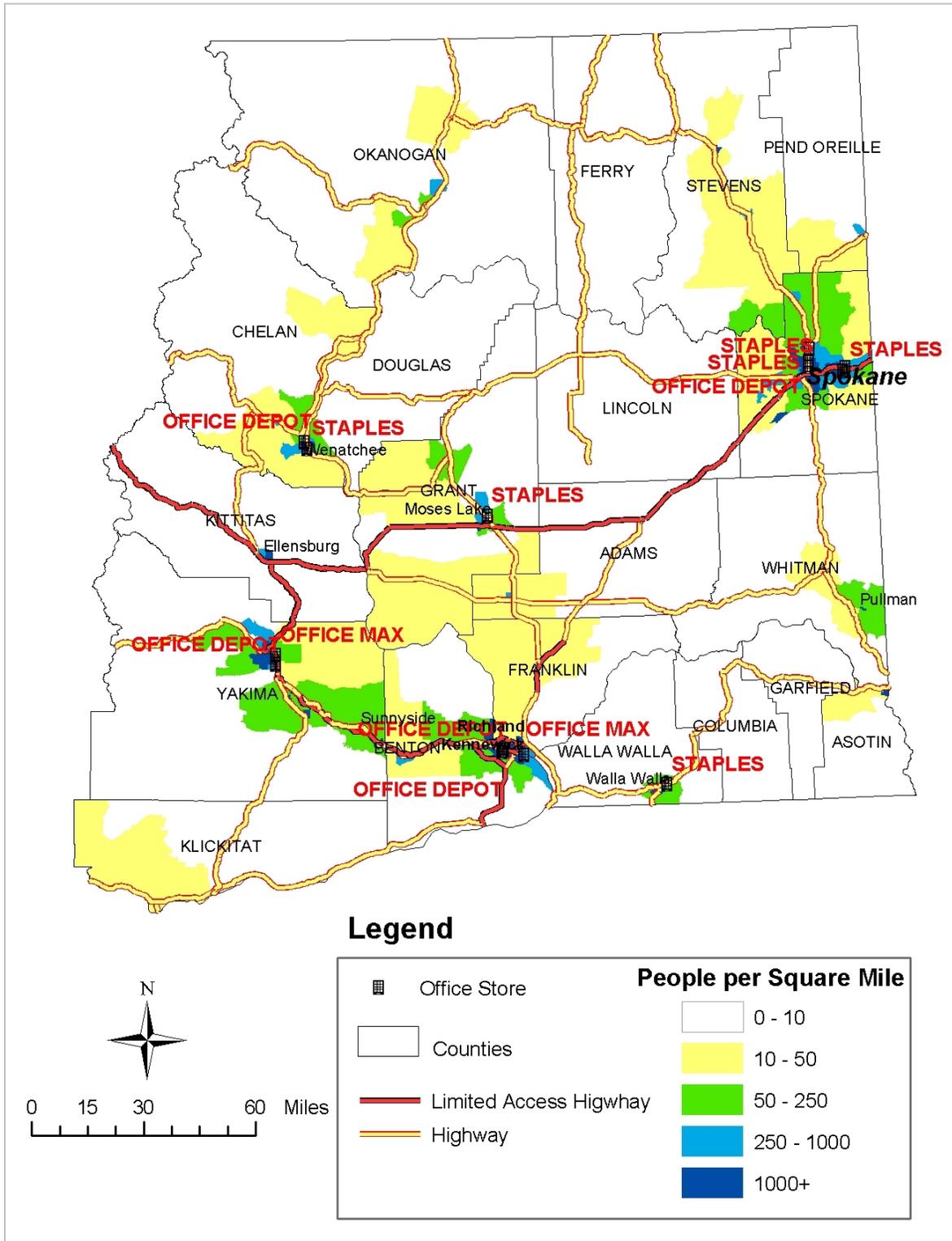
BIG BOX COMPUTER CHAINS IN EASTERN WASHINGTON

NOVEMBER 2002



BIG BOX OFFICE STORE CHAINS IN EASTERN WASHINGTON

NOVEMBER 2002



BIG BOX MASS MERCHANT CHAINS IN EASTERN WASHINGTON

NOVEMBER 2002

