Southwest Washington Electronic Waste Generation and Processing

By the Clark County Sheriff's Office
and the Washington State Jail Industries Board
for the Clark County Department of Public Works,
Environmental Services Division

CLARK COUNTY SHERIFF'S OFFICE
CLARK COUNTY WASHINGTON

Washington State
Jail Industries Board

JI BOARD

March, 2003

Southwest Washington

Electronic Waste

Generation and Processing

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Acknowledgements

This report was prepared at the request of the Clark County Department of Public Works, Environmental Services Division.

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Southwest Washington
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Executive Summary

This report was prepared by the Clark County Sheriff's Office and the Washington State Jail Industries Board at the request of the Clark County Department of Public Works, Environmental Services Division, Vancouver, Washington. Its geographic scope is the seven counties of Southwest Washington.

Goal 1: Create an inventory of the key organizations and companies comprising Southwest Washington's collection and processing infrastructure, summarizing capacities, available quantity information and what is known about environmental practices.

Result: Presently, there does not appear to be adequate infrastructure in Southwest Washington to collect or process in an environmentally sound manner the volume of e-waste that is now stockpiled or projected to be generated in the near future. Household collection is limited to special events and pick-up of e-waste mixed with the general solid waste stream. The only local avenues for larger scale reuse and recycling are the jail industries facility at the Clark County Jail Work Center, which is still in a start-up phase, and Philip Environmental Services, which is seeking to expand its market. Smaller scale processing is limited to computer reuse/resale businesses and not-for-profit organizations that do not primarily engage in recycling. No surveyed landfill or transfer station operators have immediate plans to expand their processing capabilities.

Goal 2: Create an e-waste flow diagram summarizing how material currently is handled in the study area.

Result: See the flow diagram on page 12 of this report.

Goal 3: Create a projection of e-waste flows and estimates of the current and potential capacities to handle e-waste as well as the environmental soundness of recycling processes.

Result: A realistic model that factors in the likely number of households with more than one computer and assumes various rates of growth in computer usage shows that 213,000 to 330,000 household computers will become obsolete in the five years from 2005 to 2010.

	Household Computers in Use			
Growth Rate in Computer Usage	2000	2005	2010	Computers Becoming Obsolete 2005-2010
1%	234,030	273,471	317,401	213,471
3%	234,030	301,641	386,160	301,641
5%	234,030	332,087	468,046	332,087

During that same period of time, over 151,000 business computers will reach the end of their useful life.

	Business Computers in Use			
Year	2000	2005	2010	Computers Becoming Obsolete 2005-2010
Computers	144,245	151,587	162,900	151,587

Based upon current school usage patterns and projected low growth in the student population, more than 34,000 public school computers will become obsolete from 2000 to 2010.

School Computers

Year	Computers In Use 2001	Computers Becoming Obsolete 2001-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2000-2010
Computers	21,833	21,833	12,300	34,133

City and counties governments combined will account for over 8,100 obsolete machines in the seven years between now and 2010.

City Government Computers

Year	Computers in Use 2003	Computers Becoming Obsolete 2003-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2003-2010
Computers	1,469	881	1,470	2,351

County Government Computers

Year	Computers in Use 2003	Computers Becoming Obsolete 2003-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2003-2010
Computers	3,626	2,176	3,625	5,801

While numbers of computers going obsolete in the near future are high, they are far less than the projected number of televisions that will need disposal based upon an average 8.5 year life span.

Household TV's

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Total TV's	564,911	577,047	589,183	601,319	613,455	625,590	638,347	651,104	663,860	676,617	689,374	
Obsolete/ year	66,460	67,888	69,316	70,743	72,171	73,599	75,100	76,600	78,101	79,602	81,103	**810,683**

Possible Next Steps

- More education is needed among handlers and processors regarding e-waste policy and procedures in Washington State.
- The Clark County Jail Industries Recycling program could be accessed and utilized for safe and efficient disposal of e-waste in Southwest Washington.
- The projected volume of e-waste should encourage the interest of additional private sector e-waste processors to enter the market.
- Plans created for new e-waste collection and processing services implemented now in Southwest Washington would position the region well for participation in any future program that the National Electronic Product Stewardship Initiative (NEPSI) recommends.

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Southwest Washington E-Waste Research Report

GOALS

Electronic waste, or e-waste, is defined as computers, monitors, associated peripherals, and televisions that have been or soon will be at the end of their useful life. This report on e-waste was prepared by the Clark County Sheriff's Office and the Washington State Jail Industries Board at the request of the Clark County Department of Public Works, Environmental Services Division, Vancouver, Washington.

The goals of this report are to create:

- An inventory of the key organizations and companies comprising the study area's e-waste collection and processing infrastructure, summarizing capacities, available quantity information and what is known about environmental practices.
- An e-waste flow diagram summarizing how material currently is handled in the study area.
- A projection of e-waste flows and estimates of the current and potential capacities to handle e-waste as well as the environmental soundness of recycling processes.

The geographic scope of the report includes all of the counties in the Department of Ecology's Southwest Washington Region -- Clark, Cowlitz, Grays Harbor, Lewis, Pacific, Skamania and Wahkiakum counties.

COLLECTION AND PROCESSING INFRASTRUCTURE

During March, 2003, staff conducted telephone surveys of landfill and transfer station operators, local governments, and computer reuse/resale businesses in Southwest Washington. Different surveys were used for each group to gather information about how e-waste is accumulated and handled. Information was obtained from all of the counties on their solid waste handling facilities, disposition of e-waste, and on disposal procedures for county-owned computers. Thirty-one of 37 city governments in the area responded to questions regarding their handling of city-owned computers. Nine computer-related businesses were asked about their handling practices. The surveys returned good narrative information about e-waste handling practices and numbers of computers on hand. Unfortunately, the surveys demonstrated that neither solid waste operators nor businesses have reliable quantity information on e-waste streams.

A total of 56 entities were surveyed, as detailed in Table 1.

Table 1: Entities Surveyed

Entity	Number Surveyed
City and County Governments	38
Computer Reuse/Resale Businesses	9
Landfill and Transfer Station Operators	9
Total	**56**

TRANSFER STATION AND LANDFILL OPERATIONS

Staff surveyed government-owned and contracted privately-operated facilities in all seven counties regarding:

- solid waste collection and processing infrastructure
- acceptance and handling of e-waste
- familiarity with current Department of Ecology polices on e-waste
- future plans for dealing with e-waste

Table 2: Solid Waste Collection and Processing Infrastructure

County	Landfill Used	Transfer Stations	Drop Box	Government Household Pickup	Commercial Haulers
Clark	Boardman, Or	2-Operated by Columbia Resources Co.	recycling only	Camas	Waste Management Waste Connections
Cowlitz	Cowlitz County		1	none	Waste Control
Grays Harbor	Goldendale, Wa	6- Operated by LeMay		Hoquiam	LeMay Elma Disposal
Lewis	Kittitas County, Wa	2	6	none	LeMay Waste Connections
Pacific	The Dalles, Or	2- Operated by Pacific S.W. Disposal; Royal Heights	recycling only	Long Beach Raymond South Bend	Peninsula Sanitation
Skamania	Wasco, Or	3		none	Bingen Sanitary Svs Waste Connections
Wahkiakum	Cowlitz County		4	none	Peninsula Sanitation Stanley Sanitation

Table 3 summarizes information about e-waste acceptance policies. Currently all jurisdictions accept e-waste from households. All but one jurisdiction accepts from Small Quantity Generators. Despite interim Department of Ecology guidelines that seek to limit e-waste disposal from Large Quantity Generators, several jurisdictions still accept e-waste from all sources.

Table 3: Landfill and Transfer Station E-Waste Acceptance Policies

		……..Accept From……..					
County	**Aware of CRT Policy**	**Households**	**SQG**	**LQG**	**Commercial Haulers**	**E-Waste Recycler Used /Clients Referred To**	**Notes**
Clark	Yes	Yes	Yes	Unknown	In mixed load	CREAM	
Cowlitz	Yes	Yes	Yes	No	In mixed load	CREAM Philip Environmental	2003 just starting e-waste diversion
Grays Harbor	No	Yes	Yes	Yes	Yes		
Lewis	Somewhat	Yes	Yes	Yes	Yes		Transfer Station limits quantities accepted
Pacific	Yes	Yes	Yes	Yes	Yes		
Skamania	Yes	Yes	No	No	Household only	Philip Environmental	
Wahkiakum	No	Yes	Yes	Yes	Yes		

Legend

- **CRT** – Cathode Ray Tube - major component of TV and monitor screens which contains lead and other contaminants that constitute dangerous waste

- **SQG** – Small Quantity Generator – an entity which generate less than 220 pounds of dangerous waste per month, about 5-10 monitors or televisions per month

- **LQG** – Large Quantity Generator - an entity which generate more than 220 pounds of dangerous waste per month

- **Commercial Haulers** – Private sector businesses that contract with governments to collect household waste and with businesses to collect commercial and industrial waste.

- **CREAM** – Computer Reuse and Marketing – a pilot project of governmental and non-profit entities in Clark County to reduce the e-waste stream and provide refurbished computers to low-income residents

E-WASTE SORTING AND PROCESSING CAPACITY

Southwest Washington currently lacks capacity to sort e-waste at landfills or transfer stations. Clark County's contract transfer station operator separates incoming computer CPU's (central processing units) for donation to the CREAM program; however, they do not separate monitors because they lack funding for disposal fees. Cowlitz County recently began separating e-waste in 2003. Skamania County does not do their own processing, but directs clients to take their e-waste to Philip Environmental Services for processing.

With the exception of Cowlitz County, none of the governmental jurisdictions surveyed have plans to change their e-waste acceptance policy or develop their own sorting or processing capabilities. All respondents noted concerns about funding, regulatory uncertainty, or both as reasons to not remove e-waste from the general solid waste stream. It appears most of Southwest Washington will take a "wait and see" attitude until diversion of e-waste is made mandatory. If diversion is mandatory, additional funding will be required to cover the extra costs.

Philip Environmental Services currently operates a hazardous waste acceptance facility in Washougal, Clark County. The company is seeking to expand its e-waste processing business and will accept e-waste for a disposal fee. This is the only commercial e-waste processor physically located in Southwest Washington. Other commercial processors are available out-of-state. No handling capacity information is available.

Clark County Jail Industries, an operation of the Clark County Sheriff's Office in Vancouver, acts as the e-waste processor for the CREAM program. It can accept donations of household computers, monitors, and peripheral equipment which will either be refurbished for re-use or recycled. Jail Industries can also process equipment from governmental entities or not-for-profit organizations. As this operation is still in the start-up phase, no handling capacity information is available.

SPECIAL E-WASTE COLLECTION EVENTS

County solid waste managers were asked about sponsored collection events in 2002. Only Lewis and Clark counties sponsored special e-waste collection events. Staff in Lewis County reported the collection of 28 gaylords of computers and monitors. A gaylord is a 4 foot by 4 foot cardboard box commonly used to contain recycled goods. Clark County sponsored a collection event that was actually targeted at donations of functioning computer equipment, but which netted 80% e-waste and 20% functional equipment. Totals included 65 monitors, 51 computers, and numerous peripherals. Other counties surveyed hold household hazardous waste collection events which may gather e-waste; however, e-waste is not the focus of the events and no quantity information was gathered.

City government information technology managers were also asked if they were aware of any special collection events. They also referred to general "spring clean-up" and

hazardous waste collection events, but none which specifically targeted e-waste. A number of respondents stated they would like to organize targeted events in the future.

GOVERNMENT E-WASTE DISPOSITION

Surveys of city and county government information technology managers were conducted to gather information on quantities of computers in use and what happens to those computers when they become obsolete. Contrary to anecdotes about "warehouses full of dead computers" the great majority of cities and counties stockpile obsolete computer equipment only until it is disposed of through a surplus auction. Auction is by far the most common method of disposal. Only one jurisdiction reported a significant amount of equipment in storage. Only one city and three counties reported vendor buy-back contracts allowing trade in of old equipment when equipment upgrades are made. Those jurisdictions that landfill obsolete equipment did so only for totally unusable items. Budget pressures and the common practice of passing equipment along to other departments keep computers in service as long as possible. Only a few jurisdictions reported donating old equipment. The main recipients were local school districts. Presently only Clark and Cowlitz counties report active efforts to encourage reuse/recycling of equipment at the end of its useful life. The ultimate disposition of government equipment which is disposed of through auction is unknown.

Table 4: County Government Obsolete Equipment Disposition

County	Vendor Buy Back	Surplus Auction	Storage	Landfill	Donation	Recycle To
Clark	X					Clark Co. Jail Industries
Cowlitz	X	X				Cowlitz Co. Solid Waste
Grays Harbor		X	X			
Lewis	X	X		X		
Pacific			X	X	X	
Skamania		X	X	X	X	
Wahkiakum		X	X		X	
Summary	**3**	**5**	**4**	**3**	**3**	**2**

Table 5: City Government Obsolete Equipment Disposition

City	Vendor Buy Back	Surplus Auction	Storage	Landfill	Donation	Recycle
Aberdeen		X				
Battle Ground		X				
Camas						
Castle Rock		X				
Cathlamet		X				
Centralia		X	X			
Chehalis		X	X			
Cosmopolis		X	X			
Elma		X				
Hoquaim		X				
Ilwaco		X		X		
Kalama		X				
Kelso						
La Center						
Long Beach				X		
Longview						
McCleary		X				
Montesano		X		X		
Morton		X				
Mossyrock		X				
Napavine		X				
North Bonneville		X				
Oakville		X				
Ocean Shores						
Pe Ell		X				
Raymond		X				
Ridgefield		X				
South Bend				X		
Stevenson		X				
Toledo		X	X			
Vader		X	X			
Vancouver	X	X				
Washougal		X	X			
West Port				X		
Winlock		X				
Woodland		X				
Yacolt						
Summary	**1**	**28**	**8**	**5**	**1**	

SMALL BUSINESS E-WASTE DISPOSITION

2001 data from the Employment Security Department lists 144 firms in Washington whose primary business is computer equipment repair and maintenance services without retailing new computers. Nine of these firms in Southwest Washington were surveyed on how they handle e-waste. This does not represent a scientific sample, but it does provide an idea of how small businesses are facing this issue. None of the businesses surveyed provided exact volume information. Estimates indicate the sample contains both large and small quantity generators of dangerous waste (more or less than 220 pounds per month.)

Table 6: Small Business E-Waste Disposition

Company	Location	Ecology Policy	How Unsold Items Are Handled	Disposal Charge
A & D Computers	Vancouver	yes	recycle, unusable items to landfill	no
Battle Ground Computers	Vancouver	yes	Donation, Recycle	no
Bits-N-Bites	Vancouver	yes	donation to schools, recycle, free table in store	no
Custom Built Computers	Castle Rock	no	all items sold or donated, no storage	no
DB Computers	Kelso	yes	recycle	no
Infinite Computers	Napavine	yes	donation to non-profit or schools	no
Molly's PC Shop	Ocean Shores	no	donation to school or senior centers	$10.00 for monitors
Tiger Mountain Technologies	Morton	yes	recycle, some items go to the landfill	no
Zebra Computer Repair	Centralia	yes	donate to non-profit organizations	no

PUBLIC SCHOOL AND GOVERNMENT COMPUTERS IN USE

Schools report that when computers are upgraded, older computers are reused or "passed down" as much as possible rather than being taken immediately out of use.

Tables 6 and 7 show city and county computers on hand and Table 8 summarizes quantities in use in Southwest Washington school districts. Note that the survey results are for ***functioning*** computers on hand. As indicated above, governments are not stockpiling large amounts of equipment. There are not data available on the stockpiles maintained by school districts; however, since many schools participate in donation programs such as Computers for Schools, there may be significant numbers of older computers in storage or soon to be retired from use.

Table 7: County Government Computers in Use, 2003

County	Computers on Hand	Replacement Cycle/Years
Clark	1,650	3-5
Cowlitz	540	3
Grays Harbor	400	4-5
Lewis	680	4
Pacific	138	4-5
Skamania	145	3-4
Wahkiakum	73	5
Total	**3,626**	

Table 8: City Government Computers in Use, 2003

City	County	Computers In Use	Replacement Cycle/Years
Aberdeen	Grays Harbor	150	3-4
Battle Ground	Clark	53	3-5
Camas	Clark		
Castle Rock	Cowlitz	6	10
Cathlamet	Wahkiakum	7	as needed
Centralia	Lewis	105	3-5
Chehalis	Lewis	51	as needed
Cosmopolis	Grays Harbor	6	as needed
Elma	Grays Harbor	18	as needed
Hoquiam	Grays Harbor	43	as needed
Ilwaco	Pacific	6	as needed
Kalama	Cowlitz	7	3-5
Kelso	Cowlitz		
La Center	Clark		
Long Beach	Pacific	11	as needed
Longview	Cowlitz		
McCleary	Grays Harbor	10	as needed
Montesano	Grays Harbor	22	as needed
Morton	Lewis	11	as needed
Mossyrock	Lewis		
Napavine	Lewis	13	as needed
North Bonneville	Skamania	5	as needed
Oakville	Grays Harbor	3	as needed
Ocean Shores	Grays Harbor		
Pe Ell	Lewis	3	as needed
Raymond	Pacific	21	as needed
Ridgefield	Clark	12	as needed
South Bend	Pacific	8	3-4
Stevenson	Skamania	5	as needed
Toledo	Lewis	6	as needed
Vader	Lewis	6	as needed
Vancouver	Clark	800	4
Washougal	Clark	30	as needed
Westport	Grays Harbor	16	as needed
Winlock	Lewis	7	as needed
Woodland	Cow/Clark	28	4
Yacolt	Clark		
	Total	**1,469**	

Table 9: Public School Computers in Use, 2001

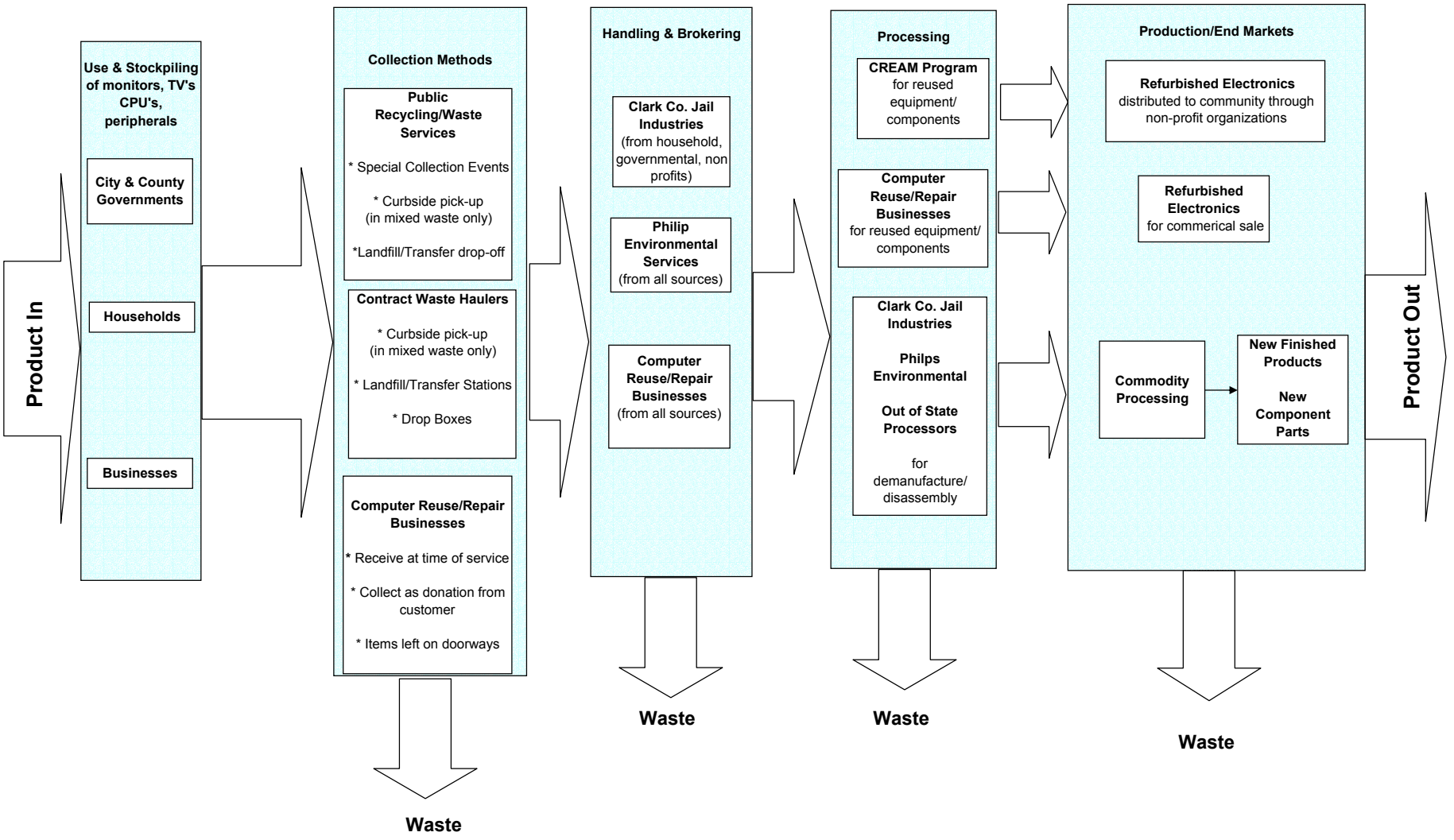
District	Enrollment	Teaching FTE	Instructional Computers with Internet Connection	Substandard Instructional Computers	Standards Based Administrative Computers	Total Computers
Battle Ground	11,470	514	492	1,014	216	**1,722**
Camas	3,634	177	582	540	67	**1,189**
La Center	1,420	64	112	229	8	**349**
Ridgefield	1,799	83	174	176	45	**395**
Vancouver	21,555	1,042	3,543	3,566	56	**7,165**
Washougal	2,523	134	300	246	67	**613**
Castle Rock	1,382	67	145	48	39	**232**
Kalama	969	45	130	50	10	**190**
Kelso	5,170	255	500	713	79	**1,292**
Longview	7,646	370	740	1,128	181	**2,049**
Woodland	1,872	94	195	184	41	**420**
Aberdeen	4,119	210	1,194	467	181	**1,842**
Cosmopolis	227	13	-	-	-	**-**
Elma	2,093	106	261	81	28	**370**
Hoquiam	2,240	111	382	163	41	**586**
McCleary	294	17	-	-	-	**-**
Montesano	1,395	70	155	65	9	**229**
North Beach	195	13	9	16	13	**38**
Oakville	326	21	23	50	6	**79**
Ocean Beach	866	42	86	54	36	**176**
Centralia	3,344	169	503	146	95	**744**
Chehalis	3,004	154	-	-	-	**-**
Morton	497	30	65	-	3	**68**
Mossyrock	632	38	-	-	-	**-**
Napavine	712	36	101	73	26	**200**
Pe Ell	302	23	80	120	7	**207**
Toledo	988	48	180	3	8	**191**
Vader	110	5	11	35	2	**48**
Winlock	845	42	147	5	365	**517**
Raymond	605	40	57	123	14	**194**
South Bend	534	34	164	2	46	**212**
Skamania	93	5	4	38	13	**55**
Stevenson	1,096	60	239	106	18	**363**
Wahkiakum	521	26	3	92	3	**98**
					Total	**21,833**

Source: 2001 Technology Survey, Office of the Superintendent of Public Instruction

AN E-WASTE FLOW DIAGRAM

The following flow chart provides an overview of e-waste handling and processing in Southwest Washington. This chart shows that there are few resources currently available that are based in Southwest Washington itself. A report prepared for Portland Metro Regional Environmental Management by Cascadia Consulting Group Assessment of E-Waste Collection and Processing Issues for the Metro Region, August, 2002, contains detailed information about Oregon-based and national e-waste processing firms, some of which currently take materials from Washington. The current relatively small scale of Washington-based recycling and reuse operations means there must be substantial stockpiling, out-of-state exports, or disposal in the general waste stream. Unfortunately, "substantial" cannot be quantified at this time, nor can the relative proportions among these options be quantified.

Figure 1: Southwest Washington E-Waste Flowchart



WASTE STREAM PROJECTIONS METHODOLOGY

There is currently no published information specifically on quantities of e-waste stockpiled or generated in Southwest Washington. Reports from local solid waste management staff and surveys from other areas indicate e-waste as a percentage of waste is small, in the neighborhood of 1%, but this information by itself is not useful for making projections.

Absent specific survey-based data for Southwest Washington, the author reviewed surveys and reports from other areas of the US on household computer and television usage, retrieved historical household computer usage information published by the US Census Bureau for the period 1990 through 1999, relied upon 1998 and 2000 Office of Financial Management Washington State Population Survey Information for 1998 and 2000 Washington household computer usage information, used national statistics developed by the US Department of Commerce for percentage of computer usage by occupation, and relied upon Washington State Office of Financial Management Projections for overall population growth. These pieces of information were applied to US Census county-level population and employment surveys to estimate the numbers of computers in use. Using estimated computers in use numbers as input, an e-waste stream model developed by Carnegie-Mellon University was used to calculate computer e-waste stream estimates.

Please see Appendix 1, Supporting Electronic Files, and Appendix 2, Estimation and Projection Methodology, for more details on computers and TVs in use and e-waste projection models.

HOUSEHOLD COMPUTERS AND MONITORS IN USE 2000-2010

The following are key assumptions used to project the number of households with a computer in Southwest Washington

- 61.1% of households in Southwest Washington counties other than Clark County had computers in 2000 (source: 2000 Washington State Population Survey).
- 73.0% of households in Clark County had computers (source: 2000 Washington State Population Survey).
- All projections start from a base of 156,020 households with computers in 2000.

In a February 2002 publication, the US Census Bureau stated that since 1997, computer use has grown at a rate of 5.3% on an annualized basis. Were this growth rate in usage to continue for the period 2000-2010, the household penetration rate would exceed 100% by 2009. A more conservative growth estimate of 3% leads to a 92% household penetration ratio by 2010. Even assuming minimal growth of 1% annually, 75% of households would have a computer by 2010.

Table 10: Households with Computers, 1990-1999

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
House-holds with Computers	30,570	34,846	39,230	43,887	47,590	57,550	67,894	72,281	97,311	109,614

Table 11: Households with Computers, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total House-holds	230,576	235,529	240,483	245,436	250,390	255,343	260,550	265,757	270,963	276,170	281,377
Households With Computers											
1% Growth Rate in Usage	156,020	161,104	166,274	171,532	176,878	182,314	187,979	193,738	199,594	205,548	211,601
3% Growth Rate in Usage	156,020	164,294	172,925	181,925	191,310	201,094	211,448	222,242	233,494	245,220	257,440
5% Growth Rate in Usage	156,020	167,484	179,705	192,730	206,607	221,391	237,310	254,268	272,328	291,558	312,030

Knowing the numbers of households with computers is useful for establishing the minimal number of computers in use; however, a 2000 survey by the Massachusetts Department of Environment Protection showed a significant percentage of households have more than one computer.

- 18% of computer owners own two computers
- 10% of computer owners own three computers
- 4% of computer owners own more than three computers

Assuming that similar rates hold true in Washington and that the relative percentage of multiple computer households remains constant over the ten year period, it is possible to develop reasonable estimates of household computers in use as detailed in Table 10.

Table 12: Household Computers in Use, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1% Growth Rate in Usage	234,030	241,656	249,412	257,298	265,317	273,471	281,968	290,607	299,391	308,322	317,401
3% Growth Rate in Usage	234,030	246,441	259,387	272,888	286,956	301,641	317,172	333,363	350,240	367,830	386,160
5% Growth Rate in Usage	234,030	251,226	269,558	289,095	309,911	332,087	355,965	381,401	408,491	437,337	468,046

The number of monitors was projected based on the assumption that there is one monitor per computer, resulting in 468,046 monitors in use by 2010. There is no distinction made between CRT (cathode ray tube) and flat panel display monitors.

BUSINESS COMPUTERS AND MONITORS

Projections of business computer usage were made by taking 2000 US Census Bureau figures for employment by county and occupation, factoring in projected growth in employment, and applying current, national figures on percentage of employees using computers by occupational groups developed by the U.S. Department of Commerce. It was assumed that the percentage of employees using computers by occupational group remains constant over the ten year period, and that there is one computer and one monitor per employee using a computer.

No attempt was made to estimate the number of computers in use prior to the year 2000. The estimated number of business computers in 2000, an installed base of 144,245, was the basis for projections through 2010.

Table 13: Business Computers in Use, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Management, Professional and Related	61,930	62,778	63,625	64,473	65,321	66,168	67,312	68,456	69,600	70,744	71,888
Service	10,714	10,885	11,055	11,226	11,396	11,567	11,764	11,961	12,158	12,356	12,553
Sales and Office	49,205	49,643	50,081	50,519	50,958	51,396	52,062	52,729	53,396	54,062	54,729
Farming, Fishing and Forestry	1,014	1,011	1,008	1,005	1,002	1,000	1,001	1,003	1,005	1,007	1,009
Construction, Extraction and Maintenance	6,418	6,449	6,479	6,510	6,541	6,572	6,661	6,750	6,839	6,928	7,016
Production, Transportation and Material Moving	14,964	14,948	14,933	14,917	14,901	14,885	15,049	15,213	15,377	15,541	15,706
Total Business Computers in Use	**144,245**	**145,713**	**147,182**	**148,650**	**150,119**	**151,587**	**153,850**	**156,112**	**158,375**	**160,638**	**162,900**

COMPUTER AND MONITOR OBSOLESCENCE

Students and staff at Carnegie Mellon University developed a detailed model of personal computer disposition. Given the estimates of computers and monitors in use detailed above, this model was used to estimate the number of household computers and monitors that have been or will become obsolete (reach the end of their estimated useful five year life span) during the period 1990 – 2010 in Southwest Washington.

Using the number of households with computers from Tables 10 and 11, and assuming one computer per household using a computer, there is projected to be a minimum of 182,314 obsolete computers generated between 1990 and 2010.

Table 14: Minimum Obsolete Household Computers, 1990-2010

(One computer per household using computers)
(One percent growth rate in computer usage 2000-2010)

Year	New Units	Obsolete Units
1990	30,570	0
1991	4,276	0
1992	4,384	0
1993	4,656	0
1994	3,704	0
1995	9,960	30,570
1996	10,344	4,276
1997	4,387	4,384
1998	25,030	4,656
1999	12,303	3,704
2000	46,406	9,960
2001	5,084	10,344
2002	5,170	4,387
2003	5,258	25,030
2004	5,346	12,303
2005	5,436	46,406
2006	5,665	5,084
2007	5,760	5,170
2008	5,856	5,258
2009	5,954	5,346
2010	6,053	5,436
Totals	**211,602**	**182,314**

Given the estimates produced on multiple computer households in Table 12, resulting in an installed base of 234,030 computers in 2000, it is realistic to project higher numbers of obsolete machines based on various growth assumptions, as shown in Table 15.

Table 15: Multiple Computer Households Obsolete Computers, 2005-2010

Installed Base of Household Computers in 2000: 234,030

Growth in Household Computer Usage	Total Household Computers in 2010	Number Becoming Obsolete Between 2005-2010
1%	317,401	273,471
3%	386,160	301,641
5%	468,046	332,087

Because there is no estimate of business computers in use prior to 2000, calculating the number of obsolete business computers depends upon using the installed base of computers in 2000 and factoring in a five-year life span. This does not account for the computers becoming obsolete that were in use prior to 2000, but it provides a reasonable estimate of e-waste generation in 2005-2010.

Table 16: Obsolete Business Computers, 2005-2010

Installed Base 2000	Installed Base 2010	Number Becoming Obsolete Between 2005-2010
144,245	162,900	151,587

Obsolete public school computers are projected separately because they will become an expense for local school districts. Also, instructional computers (those used by students) are not captured in the business computer projections. As noted above, "obsolete" does not necessarily mean the computers immediately enter the waste stream. Older computers are often "handed down" to younger students or to schools with fewer computers, resulting in a longer average life span.

Table 17: Obsolete Public School Computers, 2001-2010

Year	Computers in Use 2001	Computers Becoming Obsolete 2001-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2001-2010
Computers	21,833	21,833	12,300	34,133

Numbers of obsolete city and county government computers are already accounted for in overall business computer statistics, however, they are broken out here since they represent a direct future expense on the part of local governments.

Table 18: Obsolete City Government Computers, 2003-2010

Year	Computers in Use 2003	Computers Becoming Obsolete 2003-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2003-2010
Computers	1,469	881	1,470	2,351

Table 19: Obsolete County Government Computers, 2003-2010

Year	Computers in Use 2003	Computers Becoming Obsolete 2003-2005	Computers Becoming Obsolete 2005-2010	Total Obsolete Between 2003-2010
Computers	3,626	2,176	3,025	5,801

HOUSEHOLD TVS

The minimum projection for number of TVs in use is based on the figure that 98% of households in 2000 had at least one TV, according to the TV Turnoff Network and Nielson Media Research.

Table 20: Households with a Television, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
HH's	225,964	230,819	235,673	240,527	245,382	250,236	255,339	260,441	265,544	270,647	275,749

As is the case with household computers, it is more realistic to assume that many households have more than one TV. For purposes of 2000 – 2010 projections of total TVs in Southwest Washington households (whether in use or "stockpiled"), the results of a Massachusetts Department of Environmental Protection survey were applied to estimates of the number of households.

Table 21: TVs in Use, Including Multiple TV Households, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TVs in Use	564,911	577,047	589,183	601,319	613,455	625,590	638,347	651,104	663,860	676,617	689,374

A simple estimate of the number of households becoming obsolete per year was obtained by dividing the total number of TVs in use by an average TV lifespan of 8.5 years.

Table 22: Household TVs Becoming Obsolete, Per Year, 2000-2010

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Total TVs	564,911	577,047	589,183	601,319	613,455	625,590	638,347	651,104	663,860	676,617	689,374	
Obsolete/ year	66,460	67,888	69,316	70,743	72,171	73,599	75,100	76,600	78,101	79,602	81,103	**810,683**

Note that this number estimates only ***household*** TVs that reach the end of their average lifespan. It does not take into account the substantial number of TVs in non-household situations such as businesses, entertainment establishments, hotels, etc.

Summary

Results of this analysis demonstrate that Southwest Washington currently lacks the capacity to recycle e-waste effectively and in an environmentally sound manner. There does not appear to be adequate infrastructure to either collect or process the volume of e-waste that is now stockpiled or projected to be generated in the near future.

- Household collection is limited to special events and pick-up of e-waste mixed with the general solid waste stream.
- The only local avenues for larger scale reuse and recycling are the jail industries facility at the Clark County Jail Work Center, which is still in a start-up phase; and Philip Environmental Services, which is seeking to expand its market.
- Small scale processing is limited to computer reuse/resale businesses and not-for-profit organizations that do not primarily engage in recycling.
- No surveyed landfills or transfer stations have immediate plans to expand their processing capabilities.

POSSIBLE NEXT STEPS

- More education is needed among handlers and processors about policy and procedures of handling e-waste in Washington State.
- The Clark County Jail Industries Recycling program could be accessed and utilized for safe and efficient disposal of e-waste in Southwest Washington.
- The projected volume of e-waste should encourage the interest of additional private sector e-waste processors to enter the market.
- Plans created for new e-waste collection and processing services utilized now in Southwest Washington would position the region well for participation in any future program that the National Electronic Product Stewardship Initiative (NEPSI) recommends.

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Southwest Washington Electronic Waste Generation and Processing

Appendix 1 Supporting Electronic Documents

1. SW School Data, Excel Spreadsheet
   Computers on Hand, 2001, Southwest Washington School Districts

2. E-Waste Data, Excel Spreadsheet
   County Solid Waste Survey
   County IT Survey
   Obsolete County Computers
   City IT Survey
   Obsolete City Computers
   County Solid Waste Contacts
   Computer Businesses Survey

3. E Flow Chart 3 27 03, Excel Spreadsheet

4. SWWAE Projection, Excel Spreadsheet

Household Number Projections-One Computer per Household

90.00hh 1990-2000 Number of Households Projection

hhwc90.99 1990-1999 Households with Computers
obs90.99 Obsolete Computers Projection

hhproj 2000-2010 Number of Households Projection
hhwc 2000-2010 Number of Households with computers
obshhwc Obsolete Computers Projection

2000-2010 Projections- Multiple Computer Households

hhcomp5.0 5% growth rate in usage
obs1 Obsolete Computers Projection

hhmonitor 5.0 5% growth rate in usage
obs2 Obsolete Monitors Projection

hhcomp3.0 3% growth rate in usage
obs3 Obsolete Computers Projection

hhmon3 3% growth rate in usage
obs4 Obsolete Monitors Projection

hhcomp1.0 1% growth rate in usage
obs5 Obsolete Computers Projection

hhmon1 1% growth rate in usage
obs6 Obsolete Monitors Projection

2000-2010 Projections – Business Related

occproj Occupational Projections 2000, 2005, 2005

occproj2 Occupational Projections by year, by county, 2000-2010 and by occupational category and year

buscomp Computers used at work projection 2000-2010
obs7 Obsolete Computers Projection

busmon Monitors used at work projection 2000-2010
obs8 Obsolete Monitors Projection

2000-2010 Projections – TV

hhwtv Worksheet to determine total number of TV's by county, multiple TV households

#tvs Total TVs by county projection 2000-2010

Southwest Washington Electronic Waste Generation and Processing

Appendix 2 Estimation and Projection Methodology

DATA	SOURCE
Population figures-actual	US Census Bureau Washington Office of Financial Management
Projections-household population	Washington Office of Financial Management
Projections-employment growth by occupation	Washington Employment Security Department
Percentage computer use at work by occupation	US Department of Commerce
Percentage households with computers	US Census Bureau US Department of Commerce Washington Office of Financial Management
School/government computers in use	Telephone survey, 2003
Small business processors	Telephone survey, 2003
Transfer/landfill operations	Telephone survey, 2003

Assumptions and Data

Estimated Households with Computers 1990-1999
Based on US average figures

- Not geographically segmented.
- Not economically segmented.

Projected Households with Computers 2000-2010
2000 initial condition per 2000 Washington Population Survey, Office of Financial Management

- 73% of Clark County households had a computer.
- 61.1% of other SW counties had a computer.

Obsolete Household Computers
Minimal estimates of obsolete household computer and monitor generation were using the following assumptions:

- There was no attempt made to estimate the number of households with computers prior to 1990 and therefore no “stockpiling” information is available prior to 1990.

- The percentage of Washington households with computers mirrored the national average between 1990 and 1997. (2001 national data showed that in fact, Washington had the fourth highest household computer usage in the country, however, there is not sufficient Washington-specific data to support a higher *past* usage estimate. It is probable that the actual usage was higher.)

- All household computers purchased before 1991 were purchased in 1990, resulting in an installed base of 30,570 households with computers in 1990.

- All households with computers between 1990 and 1999 were assumed to have one computer and one monitor, as there were not sufficient historical data on multiple computer households to make a multiple computer estimation.

- Growth in household computer usage is equivalent to addition of new computer units.

- Both computers and monitors have a useful life of five years.

Projected Computer Use by Occupation
Base employment from 2000 US Census Data

- Employment growth rates by occupation from Washington Employment Security Department.

- One computer per employee who uses a computer.

Televisions per Household

- 98% of households have at least one television.

- Households with multiple televisions follow the Massachusetts study % applied to Washington households.

Cities Projections

- Telephone survey results for 2003 information.

- 2003 installed base 2200 computers.

- These purchased over past five years.

- No growth in installed base 2003 forward.

- Average of 20%/five year replacement cycle.

- Note that these numbers should be captured in the computers by occupation projections.

Counties Projections

- 2003 installed base 3355 computers.
- These purchased over past five years.
- No growth in installed base 2003 forward.
- Average of 20%/five year replacement cycle.

School Projections

- Projections starting with 2001 installed base, per 2001 Tech Survey Conducted by the Office of Superintendent of Public Instruction.
- Substandard computers purchased 95, 96, 97.
- Standard computers purchased 98, 99, 2000.
- No growth in installed base from 2001 forward.
- 20% annual replacement factor 2001-2010.
- Note that Caseload Forecast Council projects 0.1% growth in school populations through 2010.