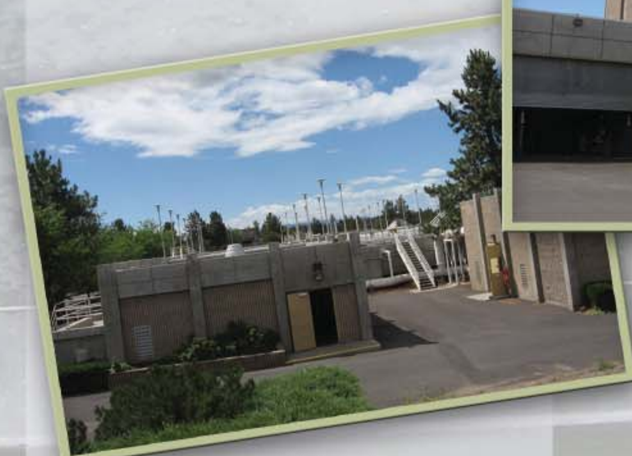
Executive Summary

Water Reclamation Facilities Plan

City Project No. SW0701

February 2008



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INTRODUCTION

As the City of Bend continues to experience rapid population growth, the need to expand its wastewater treatment system is imperative to continue to protect the sensitive surrounding environment. The Water Reclamation Facility (WRF), constructed in 1981, has served the community well, aided by timely upgrades to keep the facilities modern and in compliance with ever tightening regulations. Now, with Bend as the sixth-fastest-growing metropolitan area in the United States, the WRF is approaching its capacity limits and is due for a major expansion.

The City has just completed the WRF Facilities Plan (Facilities Plan), a comprehensive study of the plant's ability to meet future flows given the capacity and current condition of each process element. With the aid of Carollo Engineers, one of the original facility design firms, the City has outlined several cost-effective solutions for increasing the plant's ability to meet projected wastewater flows through the year 2030. The Facilities Plan will be used to obtain Oregon Department of Environmental Quality (DEQ) approval and potential funding for the improvements through the State Revolving Fund (SRF) program.

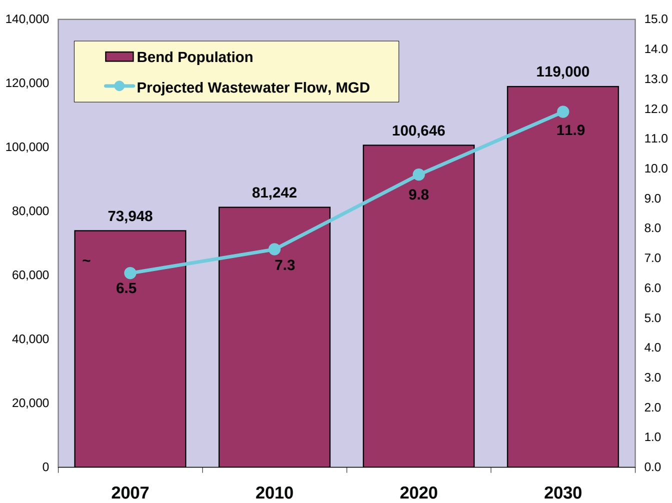

FIGURE 1: Population & Flow Projections. Population and WRF influent flow will nearly double by 2030, requiring expansion for nearly all treatment processes.

EXISTING TREATMENT FACILITIES

Many of the original facility components, still in operation, are state-of-the-art technologies. Previous upgrades include two new seepage ponds around 1983, construction of a new solids handling building in 1996, upgrades to the secondary treatment process in 2000, and addition of the cloth media filters for reclaimed water production around 2000. Effluent from the WRF is applied either to the existing seepage pond system or as reclaimed water.

Performance and Deficiencies: All treatment processes have been very well maintained, and in nearly all cases are performing well and meeting performance criteria. Exceptions include the two original anaerobic digesters and the headworks facility. However, the City has already taken steps to address these deficiencies, which include a new headworks and upgrades to the digester mixing system. Based upon the significant increase in influent flows and loads described below, a number of processes do not meet the projected capacity requirements through 2030. In fact, several major liquid treatment processes are already operating at capacity and need to be expanded in the near-term.

WASTEWATER FLOWS AND LOADINGS

Current and projected wastewater flows and loads were calculated based on population projections developed in conjunction with the City's other planning efforts, including the Collection System Master Plan. A significant portion of the population increase (approximately 10,000) results from adding unsewered residences to the service area. As shown in Figure 1, the increased population will require the WRF to treat a future average daily max month flow (ADMMF) of 11.9 million gallons per day (mgd), compared to 6.5 mgd today. Plant loads, such as Biochemical Oxygen Demand (BOD), a measure of organic materials, and total suspended solids (TSS) will also increase, demanding higher treatment capacity.

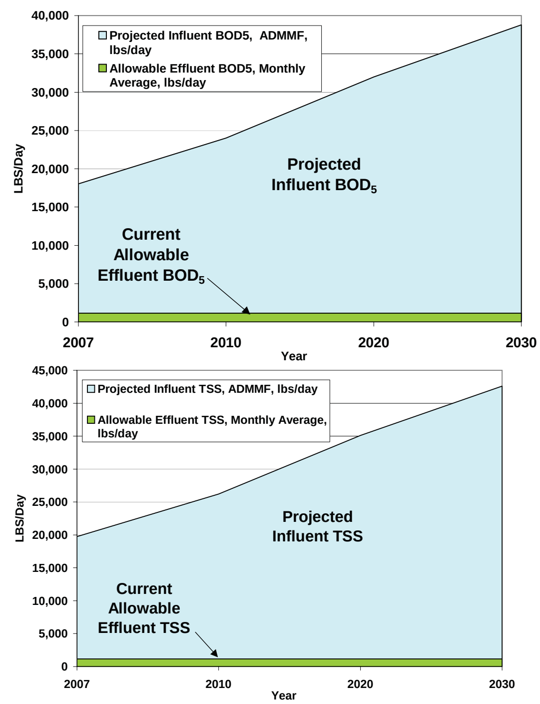

FIGURE 2: Projected BOD and TSS Loads

REGULATORY REQUIREMENTS

The WRF effluent discharges are regulated under the terms of a Water Pollution Control Facility (WPCF) permit issued by the DEQ. A portion of the effluent is treated to Level IV reclaimed water standards, which requires additional treatment.

The Facilities Plan includes an extensive analysis of potential future groundwater impacts from the plant discharge, which resulted in findings that the current effluent limit on total nitrogen (TN) of 10 mg/L is protective of groundwater quality. Therefore, the recommended improvements in the Facilities Plan are based on continuing to meet the current requirements. However, the plan also includes alternatives to phase in additional improvements if more stringent effluent TN limits are adopted in the future. This approach ensures that proper provisions are made in near-term upgrades to allow the City to cost-effectively meet the various permitting scenarios with an efficient, phaseed approach.

RECOMMENDED IMPROVEMENTS

Expansion alternatives were evaluated based upon their respective life-cycle value, which include capital, operational, and maintenance costs, to identify the most cost- effective solution to increase capacity. Upgrade requirements for the liquid and solids treatment systems are described below.

Liquid Stream Treatment

A schematic diagram for the recommended liquid stream system is shown in Figure 3, and various improvements needed through the planning period are described below. These improvements were developed using proprietary software to model the existing and recommended process improvements.

HEADWORKS: The headworks includes screening facilities to remove larger, inorganic material from the wastewater, and is necessary to protect downstream liquid stream processes and insure a high-quality biosolids product is available for land application. A new headworks is currently under construction, and will provide reliable capacity through the planning period. The City saved approximately $1 million by making provisions for grit in downstream processes, rather than building a new grit removal system in the headworks.

PRIMARY TREATMENT: Primary treatment consists of primary clarifiers, which are used to settle solids ahead of the aeration basins. These solids are currently held in the clarifiers for thickening prior to being pumped for subsequent stabilization in the anaerobic digesters. The results indicate that the two existing primary clarifiers do not have sufficient capacity, and the following improvements are recommended:

- Near-term
  - New (65') Primary Clarifier
  - Clarifier Splitter Box
- 2019
  - New Primary Clarifier

The recommended approach also includes building new gravity thickeners to store and thicken the primary solids, instead of holding them in the clarifiers. This will result in improved clarifier performance and will also reduce the amount of digester volume needed, as described below under Solids Treatment.

SECONDARY TREATMENT: The secondary treatment system includes aeration basins, secondary clarifiers, and return activated sludge (RAS) pumps. The aeration basins have a series of aerated and unaerated zones, which are used to grow the various microorganisms needed to treat the soluble pollutants in the primary effluent. These microorganisms are settled out of the process in the clarifiers. Settled solids are either returned to the aeration basin with RAS pumps or sent to the solids thickening & digestion processes.

The current secondary treatment facilities were also deemed insufficient to meet future flows and loads. The existing "MLE" activated sludge process is well established as being a state-of-the-art treatment process for nutrient removal for facilities of this size. Three different expansion alternatives were evaluated, all based on maintaining this general process configuration. **The alternatives evaluation showed expansion with "filtrate reaeration" basins as the best option, with a savings of approximately $4 million compared to upgrading with the current MLE aeration basins.** As shown in Figure 3, the innovative, filtrate rearation involves pre-treatment of the filtrate from the dewatering process with small treatment basins prior to entering the aeration basins. The recommended approach also includes provisions to operate under a "contact stabilization mode", which will allow the plant to treat peak flows.

This filtrate reaeration provides flexibility to meet future TN limits of 6 mg/L and 3 mg/L. For a TN limit of 6 mg/L, the aeration basin hydraulic and mixed liquid recycle pumping capacity would need to be increased, with an estimated present worth cost of $2 million. To meet a TN limit of 3 mg/L, major modifications would be required, increasing the total estimated present worth cost from $14 million to $27 million.

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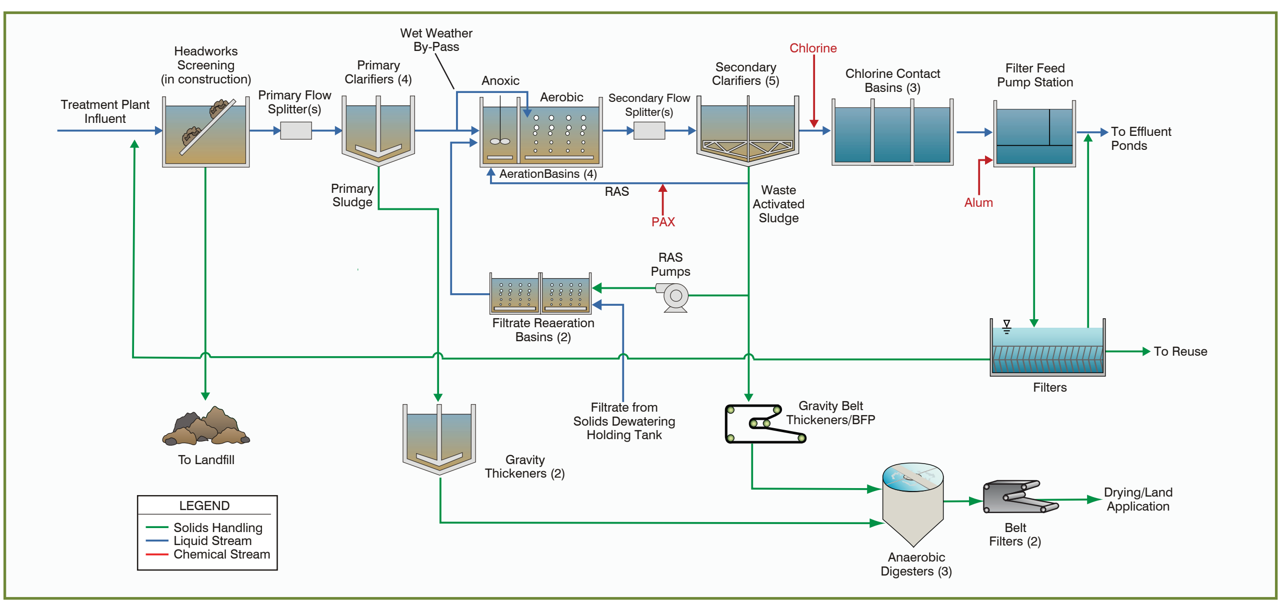

FIGURE 3: Process Flow Schematic for 2030

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To confirm the conventional secondary process is still the most effective treatment at the WRF, the Facility Plan also evaluated three membrane bioreactor (MBR) alternatives. At this time, all MBR options are significantly more expensive than the recommended approach. However, MBR cost are expected to decrease, and this alternative should be re-evaluated in the future.

The various secondary treatment improvements and their timing through the planning period are summarized below.

- Near-term
  - Two Filtrate Reaeration Basins
  - Piping to Aeration Basin for Contact Stabilization
  - New Blower to provide additional air for the aeration basin
- 2013
  - New Secondary Clarifier
  - Secondary Clarifier Flow Splitter Box
- 2019
  - New Aeration Basin
  - New Blower
- 2024
  - New Secondary Clarifier
  - New Blower

In addition to capacity issues, the existing secondary process has been plagued with intermittent periods of poorly settling solids. Near-term recommendations include installing a PAX chemical feed system, which has proven very effective at eliminating the microorganisms responsible for poor settling at the WRF. **Improved settleability with this relatively inexpensive system will reduce the secondary system upgrade requirements by approximately 30%.**

DISINFECTION: Residual bacteria that remain in the secondary effluent are treated in the disinfection process, which consists of chlorine feed system and chlorine contact basins. The plant's existing gaseous chlorine system is nearing its design capacity. Furthermore, due to the significant safety issues with chlorine gas, all major municipalities in Oregon have discontinued its use.

Based on analysis of economic and non-economic factors, conversion from gaseous chlorine to a liquid hypochlorite system is recommended. The risks associated with gaseous chlorine do not justify its reduced operating cost, and liquid hypochlorite is much cheaper than UV disinfection. In addition to converting to liquid hypochlorite, one additional chlorine contact basin is required to provide adequate contact time between the bacteria and chlorine. Currently, all summer flow is chlorinated to meet reclaimed water standards. The recommended approach includes provisions to dedicate the new basin to treat the reclaimed water portion of the flow, which requires much more chlorine than the effluent that is discharged to the ponds. Dedicated operation will result in chemical savings of over 0.5 million dollars.

Existing aeration basin capacity will be maximized by adding upstream "filtrate reaeration" basins.

Solids Treatment & Disposal

Solids treatment includes the following processes:

- Primary sludge thickening;
- Waste activated sludge (WAS) thickening;
- Anaerobic digestion, and;
- Biosolids dewatering.

Primary and WAS sludge thickening increase the solids content of these solids streams, greatly reducing the solids flow and therefore volume required to stabilize the solids in the anaerobic digesters. Prior to being land applied, digested biosolids are dewatered with mechanical dewatering followed by air drying. Recommended improvements to these solids treatment processes are described below.

PRIMARY SLUDGE THICKENING: Primary sludge is currently thickened within the primary clarifiers. Gravity thickeners were considered as an alternative approach, as they can achieve higher solids concentrations, which in turn reduces flow to the digesters by approximately 23%. Analysis indicated that the savings in digester volume more than offsets the cost of installing gravity thickeners, resulting in a savings of approximately $500,000. Therefore, the gravity thickeners were recommended for installation in 2016, when the existing digesters reach their capacity.

WASTE ACTIVATED SLUDGE THICKENING: The existing gravity belt thickener (GBT) has sufficient capacity to handle projected loads through the planning period, and will be retained. However, the dissolved air floatation unit (DAF), used as a backup, has reached the end of its useful life. A "dual purpose" belt filter press (BFP) can function as both a GBT for WAS thickening and belt press for digested sludge dewatering. This unit is recommended, as it is also desirable to provide redundancy for the existing BFP and increase dewatering system capacity.

SOLIDS STABILIZATION: The current stabilization system using anaerobic digestion is highly effective, and is an appropriate technology for this size and type of facility. This process will be retained but capacity will be increased by upgrades to the mixing systems in Digesters 1 and 2 (currently being constructed) and the primary sludge gravity thickening around 2015. With both projects in place, a fourth digester will not be required until the end of the planning period.

BIOSOLIDS DEWATERING: The BFP serves as the primary dewatering unit, with the older centrifuge acting as backup. The BFP, which has sufficient capacity through 2020, has been effective at the WRF. Although well maintained, the centrifuge has been difficult to operate. As previously discussed, a "dual use" BFP is recommended in the new-term to provide additional reliablility for the GBT and existing belt press.

ULTIMATE USE AND DISPOSAL: The WRF enjoys a successful and low-cost program of beneficial reuse of Class B biosolids with land application to local agricultural sites. This is expected to continue for the near future, and no changes are recommended at this time.

The City will save approximately $0.5 million by installing gravity thickeners to reduce digestion feed flow.

Effluent Management & Reclamation

Effluent from the WRF is directed either to two seepage ponds, or as reclaimed water for irrigating a nearby golf course. The Facilities Plan recommends continuing the goal of maximizing water reuse. The study includes an in-depth analysis of the capacity and groundwater quality considerations associated with continued use of the existing seepage ponds , as summarized below.

CAPACITY: Of the four seepage ponds used for effluent disposal, two have been taken out of regular service due to high seepage rates. The two ponds currently used will not provide enough capacity for future effluent flows. The recommended approach includes reconditioning the two ponds that are not currently used, which will provide capacity to meet future effluent flows.

Treated effluent will continue to be discharged to either the seepage ponds or as reclaimed water to a nearby golf course. Other reuse options are being pursued as well.

GROUNDWATER QUALITY: Because the DEQ has determined that the WRF treatment and disposal method has no adverse impacts on groundwater quality, the City's current permit does not require specific contaminant limits in the effluent. To confirm the safety of the effluent, the Facilities Plan compared the groundwater quality, just downstream of the ponds, to the Federal Drinking Water Standards.

Data from monitoring wells above and below the ponds confirmed that contaminant levels in the groundwater are far below the drinking water standards. The study also concludes that future estimated effluent quality will continue to have no adverse effects on groundwater quality.

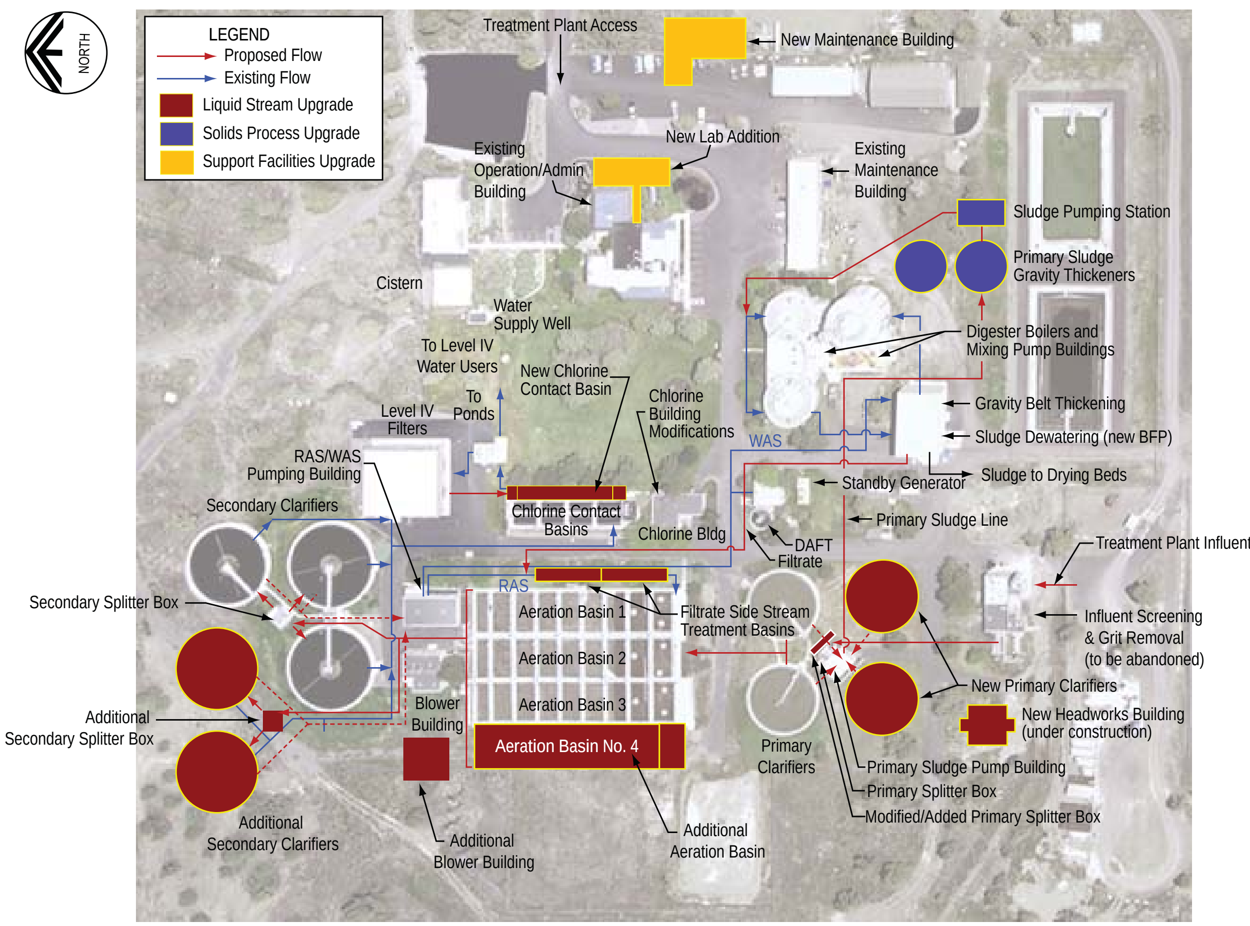
Non-Process Facilities

The adequacy of existing non-process facilities to meet current and future needs was evaluated. The results of the evaluation are as follows:

ADMINISTRATION: Administration functions are currently housed in the Operations Building. It is recommended that the existing Operations Building (including the existing water quality laboratory) be renovated to provide expanded administration and support facilities. The renovation would include three new offices, two new conference spaces, and dedicated control, break room, copy and storage, records, electrical, mechanical, and IT rooms. Overall, the changes would include a 37% increase in administration space and 260% increase in office space.

WATER QUALITY LABORATORY: The water quality laboratory is currently housed within the Operations Building. After evaluating alternatives, the recommended improvements consist of an addition along the east side of the operations building, allowing some facilities to be shared with the operations building and providing a greater cultural connection between lab and plant employees.

MAINTENANCE: It is recommended that the existing maintenance building be renovated and additional maintenance facilities be constructed. Renovations should include additional office and conference space, an expanded electrical repair area, and heavy and high bay equipment storage areas. New facilities will include new drive-through heavy equipment and lube bays, secure storage for parts and tools, a designated flammable storage area, and a new fabrication shop.



WRF Site Plan (year 2030)

CAPITAL IMPROVEMENTS PLAN

Costs for the recommended improvements are presented in Table 1, based on the year in which each project is needed to meet projected capacity requirements. The Facilities Plan includes the organization of the recommended improvements into logical packages that could be combined into a single project for design and construction.

Table 1 Capital Improvements Phasing Schedule

Bend WRF Facilities Plan

Item Description	Construction Year					
	2008-2010	2011-2013	2014-2016	2017-2019	2020-2030	Total
Liquids Treatment						
Primary Splitter Box	$370					$370
Primary Clarifier	$2,320			$2,320		$4,640
Aeration Basin				$3,930		$3,930
Contact Stabilization Piping Mods	$310					$310
Blower Building	$580					$580
Blowers	$510			$510	$510	$1,530
Secondary Clarifier Splitter		$370				$370
Secondary Clarifier		$3,120			$3,120	$6,240
Side Stream Aeration Basins	$3,290					$3,290
Blower Piping Exterior	$330			$330	$330	$990
Influent Piping Mods	$1,210					$1,210
Secondary Clarifier Piping Mods		$1,960				$1,960
Upgraded RAS Pumps	$2,460					$2,460
Upgraded WAS Pumps				$1,640		$1,640
PAX Feed System	$510					$510
Chlorine Contact Basin	$1,120					$1,120
Hypochlorite System	$920					$920
Evaporation/Percolation Ponds						
Repairs to Ponds 1 and 2				$1,310		$1,310
Solids Treatment						
Gravity Thickener System			$3,300			$3,300
Belt Filter Press	$1,250					$1,250
Support Facilities						
Renovate Admin. Building		$3,550				$3,550
New Laboratory		$3,280				$3,280
Maintenance Upgrades		$2,550				$2,550
Miscellaneous						
Misc Site Improvements (5%)	$760	$740	$170	$500	$200	$2,370
Site Piping (5%)	$760	$740	$170	$500	$200	$2,370
TOTALS (In $1,000)	$16,700	$16,310	$3,640	$11,040	$4,360	$52,050

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