Workforce Needs Assessment

INTRODUCTION

Context

In the next 5 to 10 years the stormwater, drinking water and wastewater utility industries are anticipating a growing demand for workers.

There is a workforce crisis in these utility industries caused by impending retirements and shifting demographics, increasing diversity, and a declining number of science and technical students receiving degrees. In fact, many young people are moving towards non-technical skills.

The challenges facing these three utility sectors mirror the shift in the U.S. labor force, and to an extent utilities are facing the baby-boomer exodus earlier than the general population. In the utility sector, it is projected that the exodus of utility employees due to retirement and private sector employment that began approximately five years ago will continue over the next 10 – 15 years. This represents an anticipated loss of 30 to 50 percent of the current utility workforce to retirement within 10 years.

This leaves a large gap in terms of manpower for plant operations and management, but also poses challenges for the knowledge management. Knowledge management strategies and initiatives need to be planned soon. At the same time, younger generations are not attracted to jobs in the stormwater, drinking water and wastewater industry.

New stricter national and state regulations will impact these industries, in particular the stormwater and wastewater sectors, encouraging the development of a new integrated approach to water resources management focused on sustainability of the urban hydrologic cycle. Innovative approaches in these industry's services will be required to face increasing consumer demands, increasing urbanization, emerging pollutants control, stormwater control and climate change that may affect water availability and contaminant loading. In Florida infrastructures will need to be upgraded to face continuous aging and the necessity for advanced water and wastewater treatment such as membranes and ultraviolet disinfection to respond to regulatory requirements. Consequently, the technological skills of the workforce in the overall urban water sector will have to be similarly upgraded through education and training.

Florida is challenged by many interrelated, competing demands for water, including domestic, industrial, agricultural and environmental. Balancing these demands to promote public health,

environmental stewardship, and sustained growth of the Florida economy requires integrated planning and implementation by all stakeholders.

Integrated water resources management and hydrologic cycle sustainability is the practice of making decisions and taking actions while considering multiple viewpoints of how water should be managed. These decisions and actions relate to situations such as river basin planning, organization of task forces, planning of new capital facilities, controlling reservoir releases, regulating floodplains, and developing new laws and regulations. The need for multiple viewpoints is caused by competition for water and by complex institutional constraints. In general, water agencies deal with water supply, wastewater and water quality services, stormwater and flood control, hydropower, navigation, recreation, and water for the environment, fish, and wildlife. As the practice of water resources management evolved, the term "multipurpose" (or "multi-objective") water resources development (or management) came to refer to projects with more than one purpose. Later, the term "comprehensive" water planning and management came into use to describe management practices that consider different viewpoints.

This report analyzes the workforce needs in the water resources industries (comprised of stormwater, drinking water and wastewater) in Florida focusing on three categories that resulted from previous studies as more critical: Water/Wastewater Treatment Operators, Collection/Distribution/Transmission System Operator and Mechanic/Other Maintenance Position. After a brief description of the previous studies, the results of a survey that reached 116 utilities are reported in this study. Furthermore three future challenges for the Florida water sector that will impact occupations in the next decade are here discussed.

Previous Studies

A Water Research Foundation/WERF study (*1*) reported in 2005 that the current average age of water utility workers was 44.7 and the age of wastewater workers was 45.4. The average retirement age for utility personnel was 56.

Considering the workers age, the situation was more severe for plant operators in the Northeast and the West than in the South and Midwest regions. It was also more of an issue for utilities in metropolitan areas than in non-metropolitan areas

In the American Water Works Association (AWWA) “State of the Industry Report” published in 2008 (*2*) it was projected that in the next ten years, 37% of water utility workers and 31% of wastewater utility workers will retire.

Utilities will feel the impact of these retirements most severely in areas requiring technical skills and knowledge such as Engineering, Plant Operations, Water Quality, and other technical areas

that have become increasingly difficult to recruit. A growing need for additional employees potentially by 45% in coming years is due to new regulations, infrastructure growth, security challenges and customer demands (Bureau Labor Statistics).

According to a 2005 Water Research Foundation study (*3*), retiring utility workers have worked an average of 24 years in the same utility.
In addition to the shortage in the number of workers to recruit and the need for updated recruiting methods, utilities face the risk of critical knowledge loss from employees who are exiting the organization to retirement or other options.

Utility culture is not typically focused on process and procedural documentation, knowledge sharing, or knowledge transfer – particularly in recent times of budget restrictions.

The mass exodus of utility employees together with the increasing diversity in the current workforce, the decreasing graduates in technical degrees and value differences in the younger generation of employees requires a shift in approach to operations and to move away from the "lean operation" mentality that has been forced upon utilities in recent years. A research project on *Successful Recruiting, Training and Retaining Operators and Engineers to Meet Future Challenges* was created in 2008 by the AWWA Research Foundation to identify practical methods that utilities can implement to address these issues on their organization (*4*).

In this research utilities report they have been operating well below their funded staffing level for some number of years, a factor that directly impacts training and retention of staff. Utility employees are not taking advantage of training that is offered and for which employees will be reimbursed. The same study shows that more operators than engineers are eligible to retire sooner which indicates operators as the most urgent staffing need that utilities must address.

The research indicates that utilities do track indicators of workforce changes but workforce planning (including knowledge retention) is not viewed as "strategic" within most organizations and is not given the same attention as regulatory and infrastructure issues – even though workforce planning directly addresses sustainability of the organization. Salary and benefits offered by a utility were the primary retention factor for both engineers and operators currently employed.

The traditional pools of workers shown in the research are: high school graduates, community college graduates and traditional graduates of four year colleges and universities with engineering degrees. This Florida study does not focus on filling engineering positions. Reaching the pool of high school graduates that do not go on to college provides an opportunity to bring younger workers into the industry as operators. Students just graduating from high school are going to be more computer savvy and will be comfortable working in the electronic aspects of the positions.

Community college graduates bring a broader knowledge of environmental and water resource issues to the job. With new online associate degree programs going live, anyone within the state will be able to go with this route. To help attract these graduates, utilities may want to offer packages to help advance their education and careers.

Other demographic research in the 2008 AWWA Research Foundation report identified three more pools of potential workers: retirees working full or part-time, displaced workers as a result of plant closing or layoffs and military veterans, ranging in age from 25 through 54. The report indicated that new recruiting strategies are needed for attracting these pools of applicants.

For recruiting workers 55 and older the AARP Senior Community Service Employment Program (SCSEP) is a potential group with whom to partner. The program provides subsidized, service-based training for low-income persons 55 or older who are unemployed and have poor employment prospects.

Displaced workers are a good labor pool to explore in Florida. The recent economic conditions, particularly in the construction industry have left a lot of people willing to make career changes. The benefit packages offered will be an attractor to this group.

Veterans may be the best pool of workers to market water and wastewater careers. With the availability of on-line pre-licensure courses, they may be able to start planning for their post military career while still serving. There is also funding available to help make the transition to civilian life. These workers are more mature and have productive work experience.

The importance of the knowledge management in the water industry, considering the workforce crisis just described has been addressed in the research *Organizational Development for Knowledge Management at Water Utilities* carried out by the Water Research Foundation in 2010 (*5*). The project had the objective of identifying the benefits and costs of implementing a knowledge management (KM) initiative, investigating organizational characteristics and processes critical to the success of implementing a knowledge management initiative.

Involved in the study were 207 separate drinking water utilities providing information about their organizations and KM and KM-related strategies and projects underway. The survey revealed that Knowledge Sharing, Team Decision-Making, and Knowledge Retention represent the largest number of KM strategies underway in these utilities. The largest focus in the “planning” stage is on Knowledge Retention, followed closely by Knowledge Base development and Expert Locator. More than 50% of the utilities are currently doing Knowledge Sharing and Team Decision-Making.

Thirty-three projects were collected from 22 utilities all over the country. These projects include a wide range of initiatives connected to the increasing recognition of knowledge in drinking water utilities. These initiatives not only included development of a KM plan, knowledge sharing, retaining retiree knowledge and organizational learning, but also included developing and updating manuals, professional and leadership development, public relations, work performance improvement, succession and talent resource planning, workforce planning, quality based documentation, training, communications, developing document repositories, process and operational improvements and the use of social network analysis. Three core areas have been analyzed: leadership and management; organizational structure in support of KM and critical success factors, barriers, alignment and underdevelopment. Interestingly, the results showed that the perception of responders was that the organizational structure supports the sharing of information and knowledge better than the human resources department. Any potential significant organizational change creates uncertainty, concern and fear resulting in workforce resistance that is challenging to leadership and management. The level of information system integration (consistent and accessible) and the quality of information contained in IT systems are not satisfying as perceived by responders in drinking water utilities. Barriers to the successful implementation of a KM strategy or initiative were identified as financial resources, time, resistance to change, lack of manpower, politics, leadership and management, public perception, resistance to technology, regulations and law, and culture.

Two specific tools resulted from this research project. The first is an assessment tool for utilities to identify their readiness to plan and implement KM strategies. The second is a toolkit for planning and implementing the organizational changes needed for a successful KM strategy or initiative in utilities.

The AWWA conducted a national survey in 2008 to determine water sector workforce needs and in 2009 the report of the study known as the Water Sector Workforce Sustainability Initiative (WSWSI) was published (*6*). The survey conducted by the Steering Committee volunteers targeted 40 utilities on the workforce development issues facing water and wastewater utilities. Fifty-two percent of the survey respondents were public agencies that are part of a city, county, or enterprise fund while 24% were public with independent governance. The remaining 24 % of respondents were investor owned or special operating districts.

For mission critical classifications, Water/Wastewater Treatment Operators and Collection/Distribution/ Transmission System Operators were the classifications at highest risk followed by Engineers. The operational functions most at risk for utilities were listed as Water Delivery Reliability, Customer Service, Environmental Stewardship, and Safety, Security, and Emergency Response. The highest reported workforce development challenges within mission critical positions are Recruitment and Selection, and Knowledge Retention, followed by Classification issues and Staff Training. Also this research focused on identifying utility and

other industry collaborative programs that may serve as models or resources to help define collaborative water sector initiatives.

Florida's workforce needs in the water sector was the focus of the 2007 report of the Florida's Water Future, consisting of a group of industry experts, state water associations and agencies (*7*). In this report, the greatest need is identified as water and wastewater treatment plant operators and engineers. The major challenges were: Florida demographics showing that the majority of the population is projected to move towards the retirement age by 2020 without a corresponding population moving into the workforce age; the increasingly complex technical and regulatory requirements; the knowledge management; the increasing population growth and increasing water demand and climate change for the increasing intensity of tropical storms and hurricanes.

The five utilities in Florida participating at the 2009 survey of the Water Sector Workforce Sustainability Initiative (WSWSI) identified Water/Wastewater Treatment Operators, Collection/Distribution/Transmission System Operator and Mechanic/Machinist/Other Maintenance Technician as their most critical occupations followed by Electrician/Electronic Maintenance and Engineer. Retirement was considered the highest risk factor in ensuring an adequate and prepared workforce in these positions, followed by inadequate documentation on facilities, processes, procedures, technologies and equipment and changing regulatory requirements. As for the recruitment challenges the lack of an adequate labor pool with appropriate qualifications was the higher risk factor, followed by recruitment/selection process and uncompetitive pay and/or fringe benefits.

In 2009 the Employ Florida Banner Center for Water Resources (Banner Center) was created by Workforce Florida, the State's board for carrying out workforce policy, programs and services with the aim to address both the lack of potential employees in the field as well as the need to upgrade the skills of those already working in the water and wastewater sectors. In order to systematically address the workforce shortage in the water sector, a study to assess the state of the workforce in Florida was conducted by the University of South Florida Dr. Kirian C. Patel Center for Global Solutions in 2010 (*8*). A survey was conducted in this study to identify the workforce gaps in the water sector and determine the causes of those gaps.

The survey was sent to the memberships of the Florida Rural Water Association (FRWA), the Florida Section of the AWWA (FSAWWA) Utility Council and the Utility Council of the Florida Water Environment Association (FWEA). Ultimately, 65 utilities responded. Six of the responses came from the FSAWWA/FWEA membership and the rest came from the FRWA membership.

In particular, the top three occupations in which growth is anticipated in the next five to ten years include Water/Wastewater Treatment Operators, Collection/Distribution/Transmission System Operator and Mechanic/Other Maintenance Position. These were similarly the top three occupations for which the highest retirement is projected followed by Electrician/Electronic and

also they were the top three positions for which utilities experienced or anticipated problems with quantity in terms of ability to recruit staff with adequate qualifications and/or staff work preparedness.

For these three categories the bigger challenges in hiring new employees are lack of proper training, uncompetitive salaries and poor perception of job/industry and career opportunities and followed by changing regulatory requirements.

The sector-wide initiatives that were considered to be potentially helpful in closing the workforce gap were a standardized apprenticeship program for the water sector and an internship program. Utilities also indicated that reciprocity among all states for existing certified personnel, and industry-wide credentials for the water sector would help close the workforce gap in the water industry.

In this study an educational inventory was conducted. The results showed the necessity to strengthen high school and post-secondary course offerings throughout Florida and the necessity to have more accessible training (especially for small utilities).

Finally the potential benefit from a state-wide initiative to make water jobs and careers more attractive, both materially and in terms of prestige would benefit the water industry. The results of this study pointed to the need for reviving the state-wide Banner Center for Water Resources to coordinate efforts for workforce development in the water sector.

Objectives

Over the last few years several studies have been conducted on the workforce issues for water and wastewater utilities both at the state and national level. This study follows up on these findings to investigate the future hiring trends and to determine if workforce needs have changed due to retirement age workers delaying their retirement because of economic conditions.

Many utilities have internship programs for engineering students, but this study objective is to determine how many utilities have internship and apprenticeship programs for technical/operational positions, analyzing the barriers for these programs such as age, insurance, curriculum available and lack of resources to implement.

This study investigates the actual and past enrollment in courses for operators in the water sector that are offered by state colleges and technical institutes in Florida.

Another objective of this study is to investigate the potential that ex-offenders have in filling the need for operator/technical employees. This assessment also looked at the future hiring needs of the Water Management Districts and the consulting companies that work for them.

If drinking water and wastewater are well known industries, even if continuously evolving, the stormwater sector is definitely increasing in relevance in the last decades in an integrated approach to water management. This study analyzes the perspective on rainfall-runoff control and treatment by presenting recent regulations and ongoing projects in Florida. Also the relevance of emerging pollutants is addressed.

SYSTEM OVERVIEW

Water, Wastewater, Distribution Operators

In this paragraph an overview of the critical occupational categories in the water sector in Florida is presented. According to the Florida Department of Labor, the operators in the category Water and Liquid Waste Treatment Plant and System Operators in 2010 held 5560 jobs. The historical employment and hourly mean wage since 1999 are reported in Figure 1. It is important to notice that the number of employees did not increase greatly in the past decade going from 4940 to 5560 with an increase rate of 56 jobs per year. The projection for 2018 instead shows an increase of the jobs in this category of a rate 130 jobs per year, categorizing this job together with civil engineers among the fastest growing occupations.

The distribution of this category within different industries is shown in Figure 2. In this category 74% of the employees are working in the Public Administration, followed by Utilities for 16% of the employees. A small percentage is working in Construction and Administrative and Support and Waste Management and Remediation Services, while other industries include Manufacturing, Educational Services and other Services (except Public Administration).

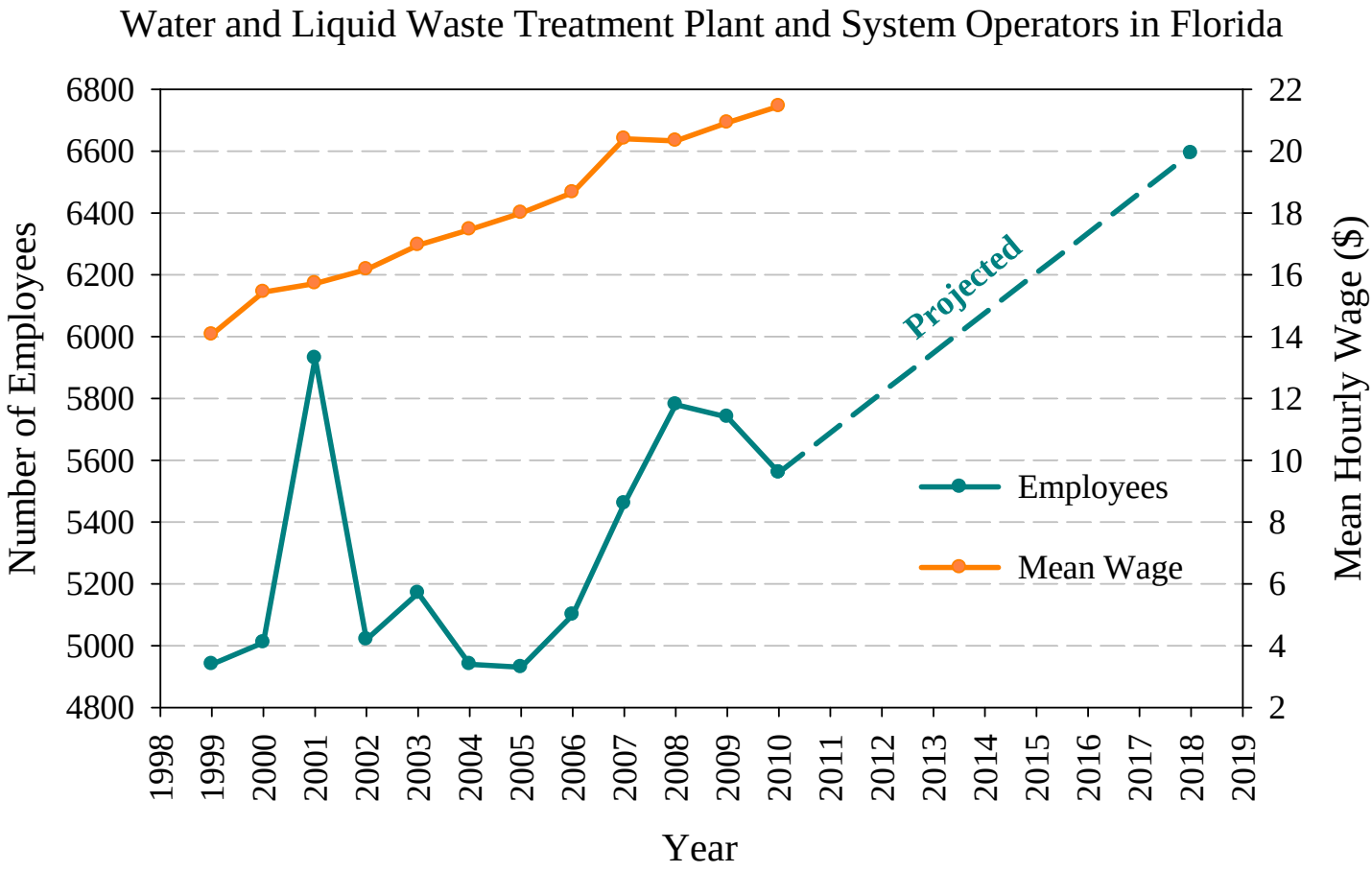

Figure 1. Historical data and occupation projection for the job category Water and Liquid Water Treatment Plant and System Operators in Florida (Census 2010).

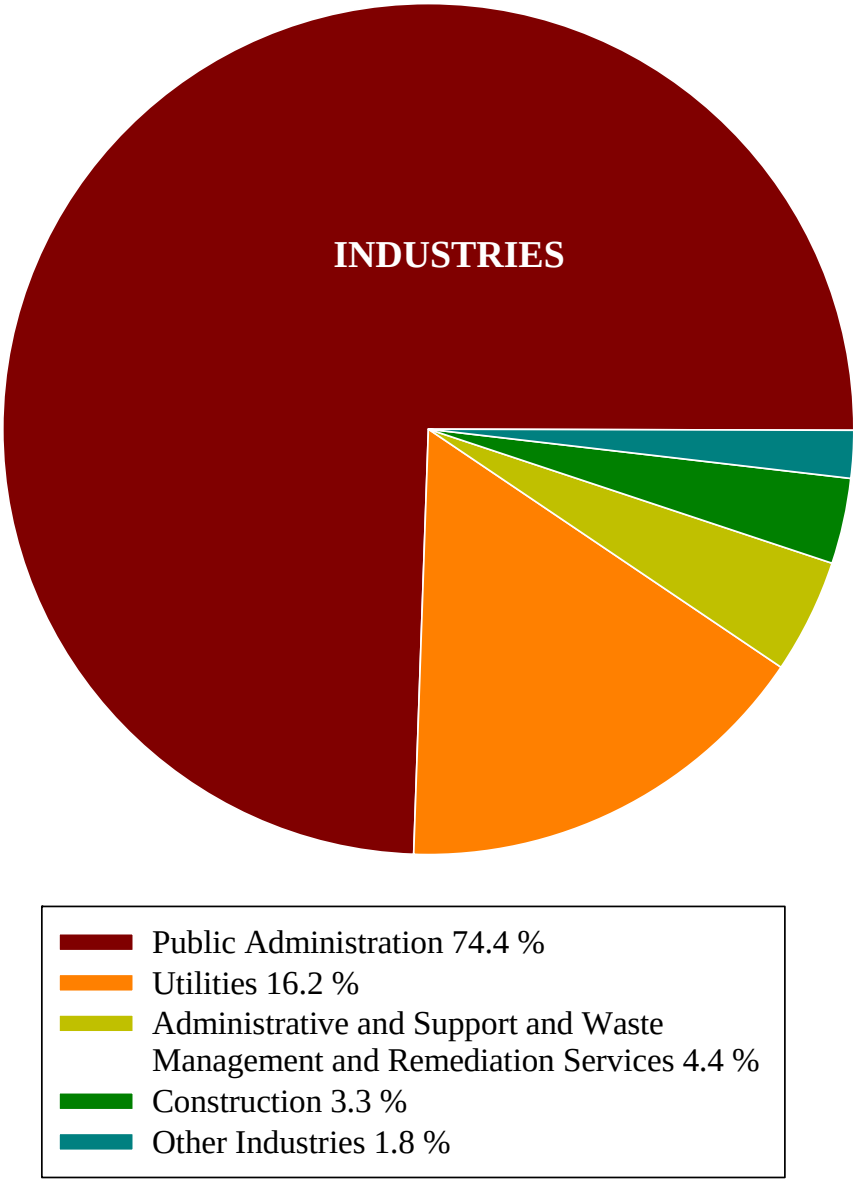

Figure 2. Distribution of the occupation category Water and Liquid Water Treatment Plant and System Operators in 2010 in Florida (Census 2010).

A more detailed analysis of the actual situation of the employees working in the water and wastewater utility industry in Florida is provided. There are three license requirements for employees working in this industry: drinking water (DW) operator license (Classes A, B, C and D), wastewater (WW) treatment plant operator license (Classes A, B, C and D) and water distribution (DS) operator license (Classes 1, 2, 3 and 4).

The average age of active and inactive drinking water and wastewater license holders in 2007 was 50 while in 2011 the average age is 51. By the age distribution reported in Table 1 it is possible to observe that 70% of the license holders were equally distributed between the two age ranges 41-50 and 51- 60 in 2007. In 2011 almost 40% of the license holders are in the 51- 60 range with 30% in the 41- 50. These results also show the small percentage of operators younger than 30 years.

The State of Florida currently has 9,321 active licensed operators (FDEP May 2011). As reported in Table 2 of these 9,321, 2,238 have drinking water licenses, 2,450 have wastewater licenses and 2,817 have water distribution licenses. There are 1748 operators holding dual licenses and 68 operators holding three licenses.

As of May 2011 there are 12,394 active and inactive licenses. Of the active licenses, as reported in Table 3, 4015 are drinking water licenses, 4192 wastewater licenses and 2998 water distribution licenses. The different classes are also reported, showing that the majority of the licenses are classes C and A for drinking water and wastewater and for water distribution classes 3 and 1 are the majority.

The number of exams administered by FDEP during five license cycles starting from 2001are reported in Table 4 together with the new licenses issued and the expired ones. The number of exams administered is comprehensive of exams to change the class within the same license type. It is interesting to note that before 2009 this number was continuously increasing. In the last two license cycles it is encouraging to note the number of new licenses if compared with the operators leaving the profession.

As for courses offered for operators in the water industry, there are currently a few public service education curriculum frameworks available in the State of Florida. These programs were developed through business and industry and are approved by the state of Florida. Enrollment in these programs is very low and has decreased significantly in the last years.

Figure 3 shows the enrollment data provided by the State of Florida Department of Education for the years 2003-2004, 2006-2007 and 2009-2010. Only 97 students took courses in the year 2009-2010 and Colleges and Institutes offering these courses were the Community School North in Broward County, the Palm Harbor Community School in Pinellas County and the Sarasota County Technical Institute. Several Florida Community Colleges offered Water/Wastewater Operator training courses in the 1970s, however, due to lack of instructors and low enrollment, most of them no longer offer these programs (*7*).

Table 5 data was provided by the State of Florida Department of Environmental Protection Operators Certification Program for the license renewal periods 2007-2009 and 2009-2011. This shows that the majority of people sitting for the state licensure exams took their required pre-

licensure courses by correspondence from California State University System, often referred to as the “Sacramento courses”.

Table 1. Drinking water and wastewater license holders in 2007 and 2011 (Source: FDEP)

Age	License Holders 2007 %	License Holders 2011 %
30 and under	3.2	4.2
31-40	14.5	13.1
41-50	34.9	28.3
51-60	35.0	38.4
61-70	10.8	14.3
71-80	1.4	1.4
81 and over	0.2	0.2

Table 2. Active licensed operators in Florida as of May 2011.

# of Held Licenses	Active Licensed Operators			
	DW	WW	DS	Total Operators
1	2238	2450	2817	7505
2	1709	1674	113	1748
3	68	68	68	68
Total	4015	4192	2998	9321

Table 3. Active licenses in Florida as of May 2011.

License Type	CLASS				Total Licenses
	A/1	B/2	C/3	D/4	
DW	1027	779	1979	230	4015
WW	1386	833	1875	98	4192
DS	667	586	1731	14	2998
% of total DW	25.6	19.4	49.3	5.7	
% of total WW	33.1	19.9	44.7	2.3	
% of total DS	22.2	19.5	57.7	0.5	

Table 4. Historical data since 2001 relative to drinking water and wastewater licenses
(FDEP May 2011)

License Cycle	Exams administered	Exams administered compared to previous exam cycle (%)	New Licenses Issued	Licenses expired	Difference between new licenses issued & expired
May 1, 2009 - April 30, 2011	3389	-0.09	939	587	352
May 1, 2007 - April 30, 2009	3707	14	970	685	285
May 1, 2005 - April 30, 2007	3266	6	754	790	-36
May 1, 2003 - April 30, 2005	3067	22	722	1391	-669
May 1, 2001 - April 30, 2003	2507	20	542	687	-145

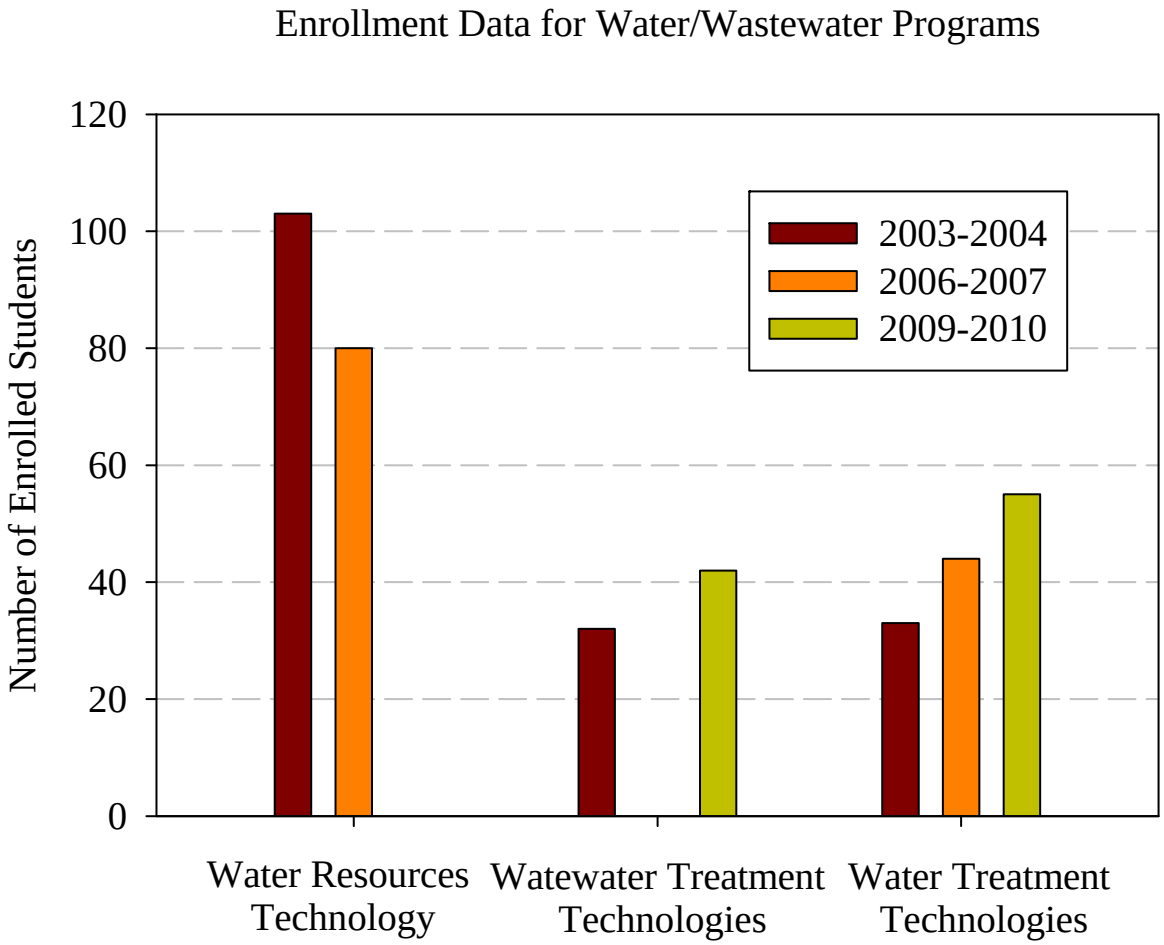

Figure 3. Enrollment data for courses offered by Community Colleges and Institutes (State of Florida Department of Education)

Table 5. 2011Providers of Required Courses for Licensure Candidates 5/1/2008-4/30/11 (State of Florida Department of Environmental Protection)

Provider	No of Students
ATC	1
BROWARD COLLEGE	6
CALIFORNIA STATE UNIVERSITY, SACRAMENTO	3817
EXAM REVIEW BOOKS	98
FLORIDA GATEWAY COLLEGE	186
FRWA	55

FS/AWWA	161
FT PIERCE UTILITY	17
FWPCOA WATER	688
HILLSBOROUGH COMMUNITY COLLEGE	40
INDIANA STATE UNIVERSITY	4
LAKE CORRECTIONAL INSTITUTION	8
LAKE TECHNICAL CENTER	13
MARION CORRECTIONAL INSTITUTION	3
MICHIGAN STATE UNIVERSITY	187
MID FLORIDA TECH	12
PALM BEACH STATE COLLEGE	90
PALM HARBOUR COMMUNITY SCHOOL	74
PIPER COMMUNITY SCHOOL.	164
PINELLAS TECHNICAL EDUCATION CENTERS	77
SARASOTA CTY TECH. INST.	30
UNIV. OF FLORIDA (TREEO and CORRESPONDENCE)	215

Water Management Sector

The future for careers at the Water Management Districts has been greatly affected by the changing economic and political climate. During this past legislative session, water management districts were directed to slash their budgets by an average of 30%. The current priority of District leadership is to deliver their core mission without having to initiate layoffs. As job vacancies are created by retirements, the positions are being eliminated or filled internally.

In the past when positions have opened up, a lot of the qualified applicants in specialized information technology or scientific fields are not citizens and the Districts had to go through the process of getting appropriate immigration documentation. With the current economic conditions, the few positions that are posted have a good pool of qualified applicants.

SURVEY

Methodology

The survey was conducted online using the software Survey Monkey. This necessitated acquiring email addresses of primary contacts at utilities. The Florida Department of Environmental Protection list of permitted drinking and domestic wastewater facilities was the first data source used. The drinking water treatment plants were sorted by population and the utilities that served a population over 3000 were chosen to receive a survey. Correspondingly, the FDEP list of wastewater facilities was sorted and utilities that produced over .100 MGD were added. Since all utilities on the FDEP lists did not have an email address listed, the FlaWARN (Florida's Water/Wastewater Agency Response Network) primary contacts were added as well as the Water Wastewater Banner Center Steering Committee contacts. The link to the survey was posted on the Banner Center website and representatives from the state associations were also encouraged to distribute to their membership. After sorting for duplications the final list had 428 contacts. To encourage participation in the study, a $250 certificate for training at the University of Florida TREEO Center was offered as an incentive to complete the survey. The survey was active for five days. Ultimately, 116 unique responses were received.

Background of Responding Utilities

The majority of the responding utilities, 77%, are publically owned, 20% are privately owned and 2.6% are contract operated as shown in Figure 4. Most of the utilities (51%) that responded to the survey are small sized with less than 50 employees as shown in Figure 5. The figure shows that 20% have between 51 and 100 employees and 16% between 101 and 250. Four utilities have more than 1000 employees. As shown in Figure 6, 36.5% of the responding utilities serve a population from 10,000 to 50,000 and 27% of the utilities serve less than 10,000 people. Geographically the responding utilities are equally distributed (between 23 and 27%) among the four Florida Water Management Districts: Northwest Florida, St. Johns River, Southwest Florida and South Florida. Only two utilities belong to Suwannee River Water Management District (Figure 7). As shown in Figure 8 the 86% of the utilities provide both drinking water and wastewater services, 9.6% only drinking water and 4.3% wastewater only.

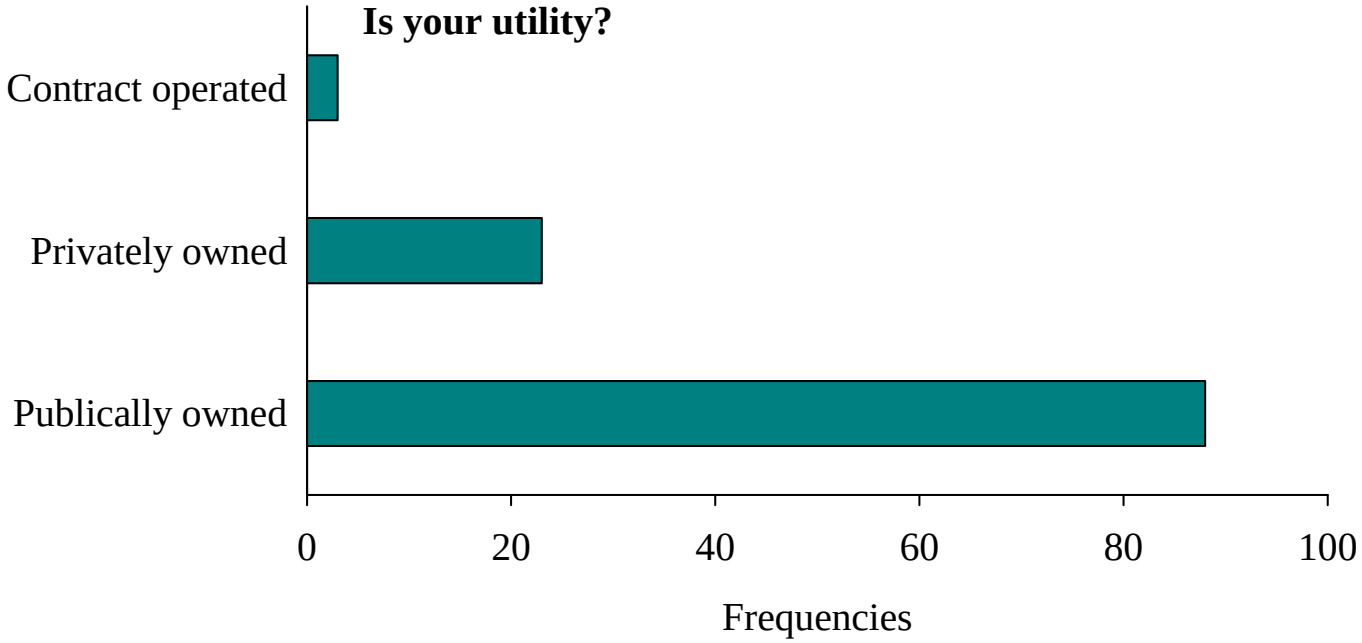

Figure 4. Characteristics of the respondent utilities

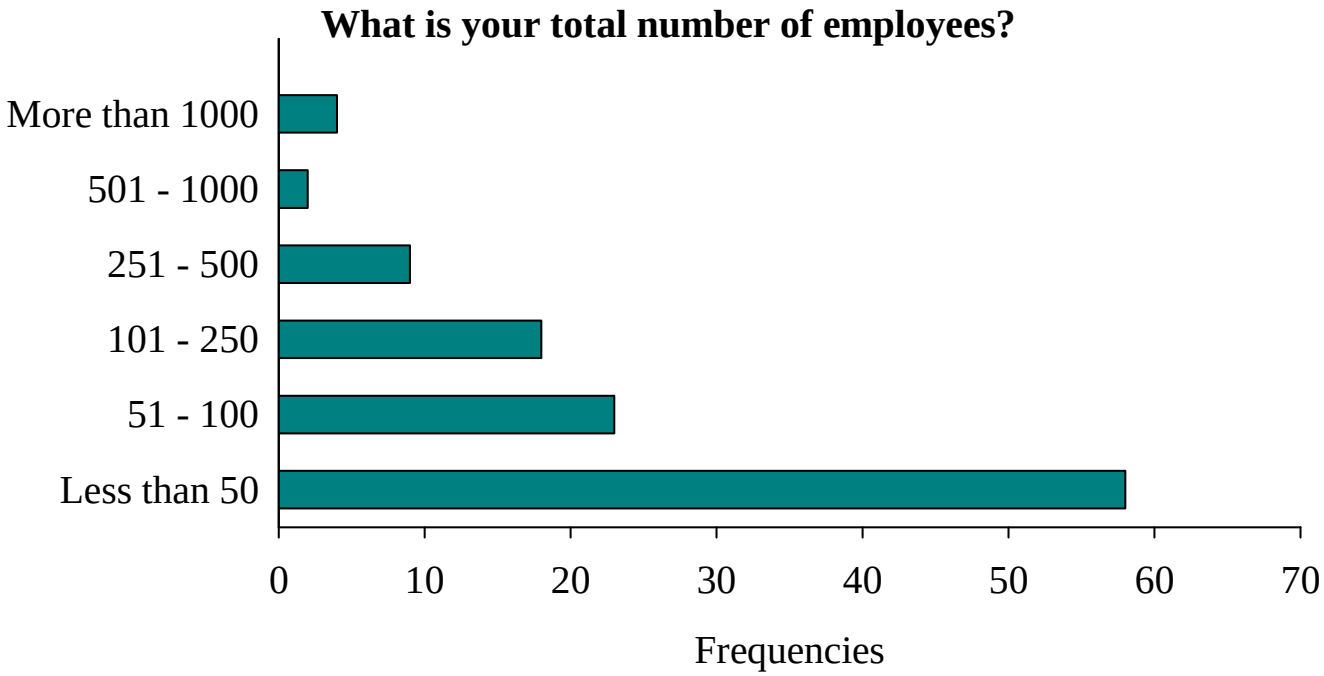

Figure 5. Number of employees at water utilities in respondent sample

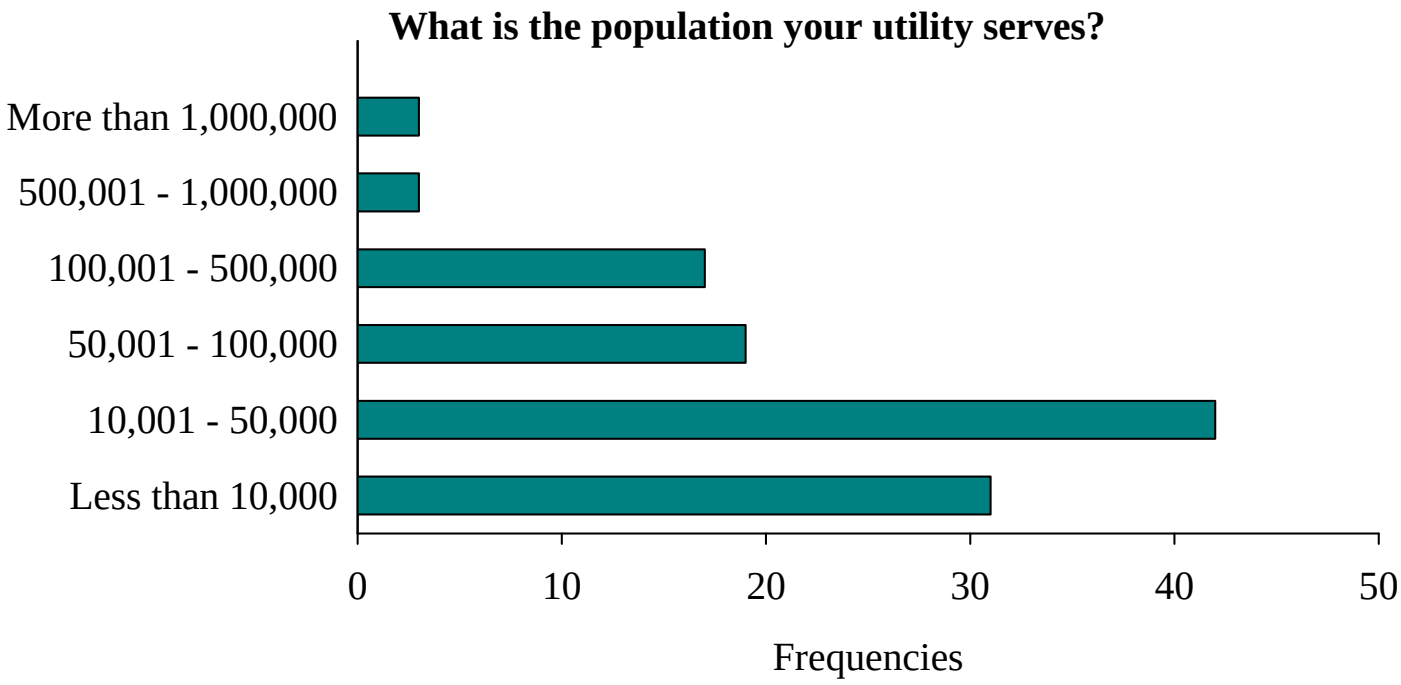

Figure 6. Population served at water utilities in respondent sample

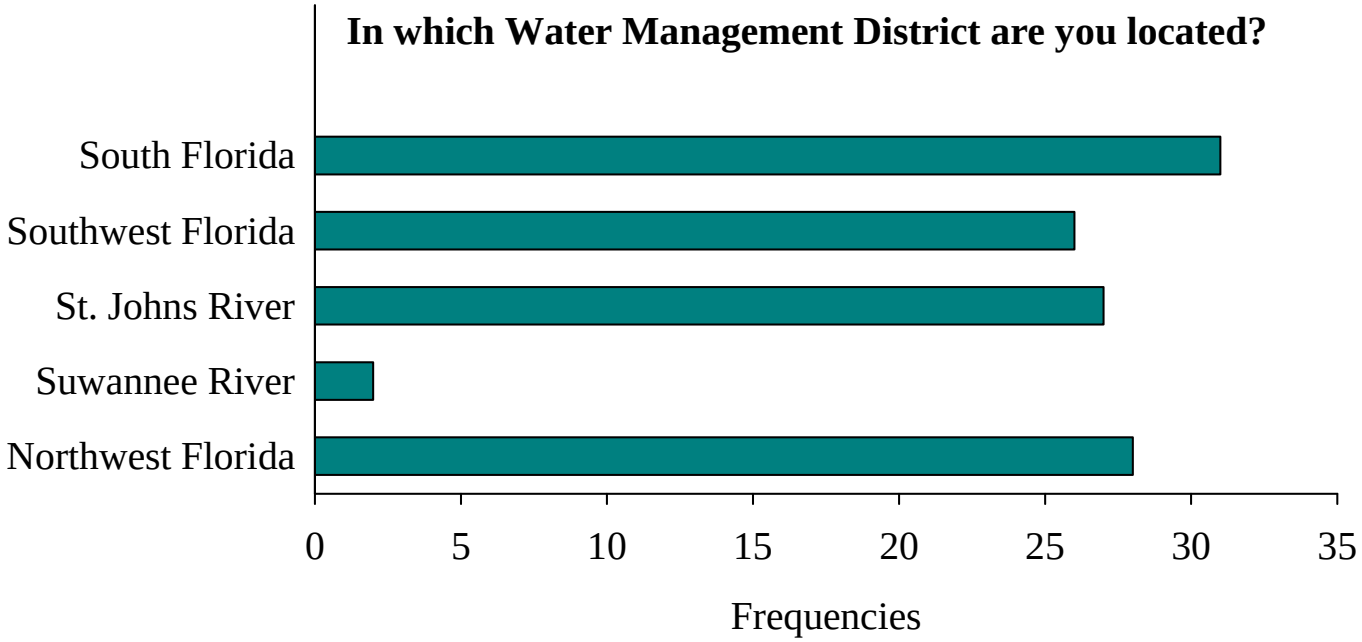

Figure 7. Number of utilities belonging to each Water Management District

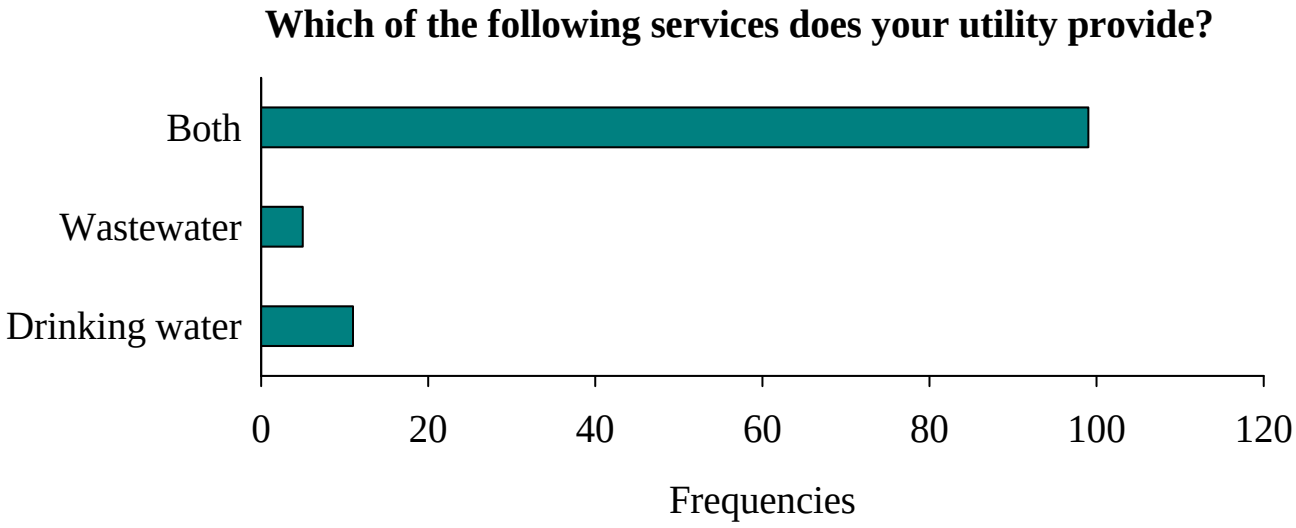

Figure 8. Services provided by the respondent utilities

Critical Occupations

From the findings of the previous Banner Center survey (*8*) and the Water Research Foundation WSWSI survey (*6*) five critical positions emerged and these positions are here further investigated. These positions are: Collection/Distribution/Transmission System Operator, Electrician/Electronic Maintenance Technician/Instrument Technicians, Lab Technicians, Water/Wastewater Treatment Operators and Mechanic/Other Maintenance Position. The utilities were asked if they were planning on hiring these positions in the next five years and the reasons for hiring them. Results of the survey are shown in Figure 9 to Figure 18. It clearly emerges that the top three required occupations in the next 5 years are the following: Collection/Distribution/Transmission System Operator, Water/Wastewater Treatment Operators and Mechanic/Other Maintenance Position. As for the other positions, 54% of the utilities will hire Electrician/Electronic Maintenance Technician/Instrument Technicians and 25 % will hire Lab Technician Positions. It also clearly emerged that the reason for hiring is mainly for future retirement more than the necessity of new positions within the utilities.

The utilities were asked if during the last two years any employee in the described critical positions deferred retirement due to the economy. As shown in Figure 19, of the 58 responding utilities from 47% to 62% observed that employees from the three categories Collection/Distribution/Transmission System Operator, Water/Wastewater Treatment Operators and Mechanic/Other Maintenance Position deferred their retirement due to the recession period.

The utilities were also asked if in the last two years they experienced delaying filling any of the critical positions due to the lower revenue projections. Interestingly, as shown from Figure 20, besides for Collection/Distribution/Transmission System Operators and partially for Water/Wastewater Treatment Operators and Mechanic/Other Maintenance Position, utilities hiring policy and needs were not greatly affected by the economy.

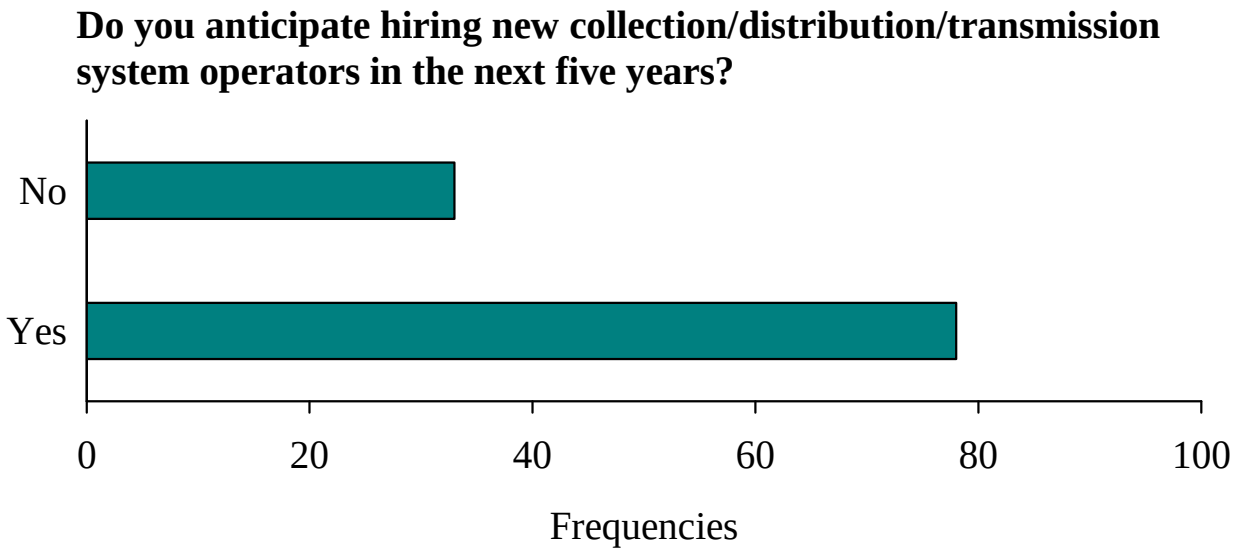

Figure 9. Hiring projection for Collection/Distribution/Transmission System Operators

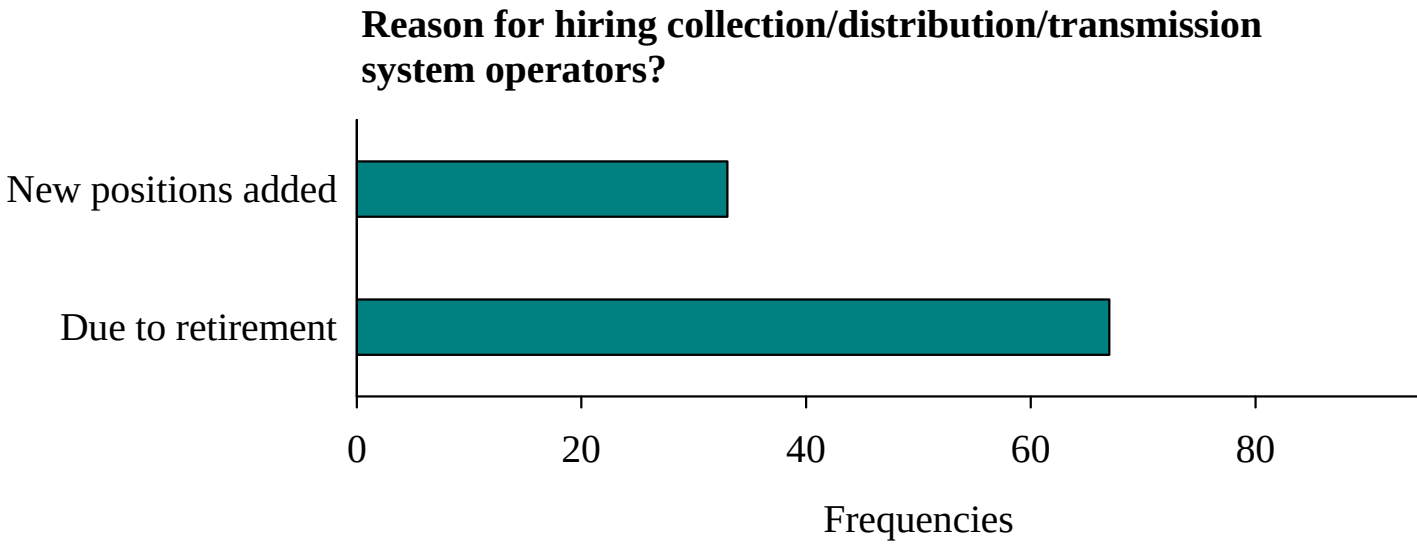

Figure 10. Reasons for hiring Collection/Distribution/Transmission System Operators

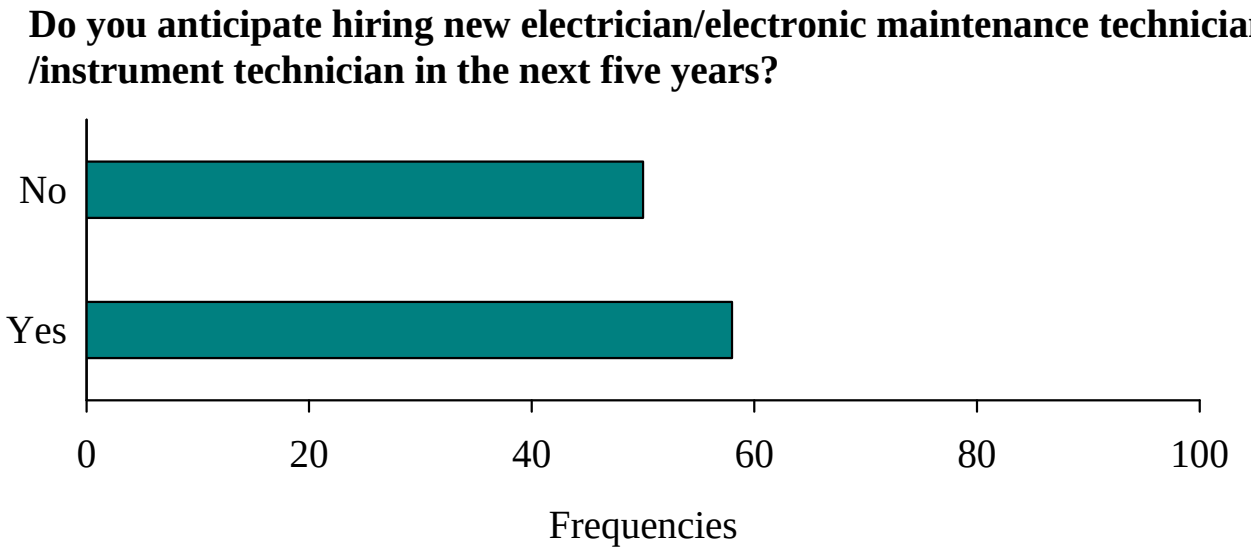

Figure 11. Hiring projection for Electrician/Electronic Maintenance Technician/Instrument Technicians

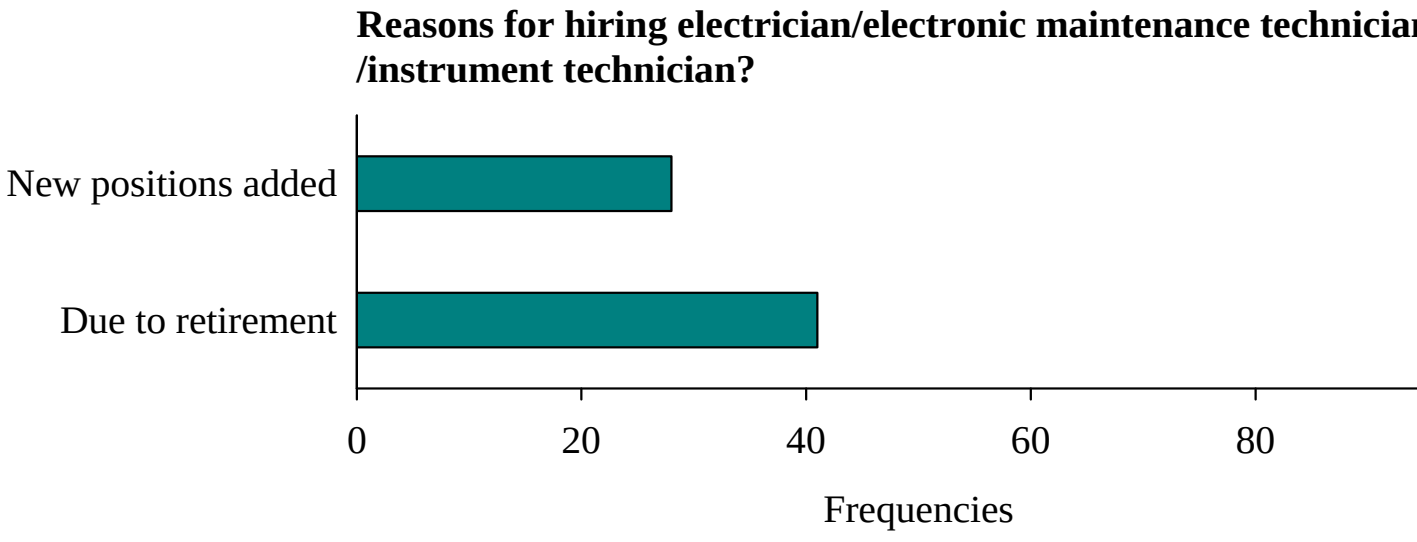

Figure 12. Reasons for hiring Electrician/Electronic Maintenance Technician/Instrument Technicians

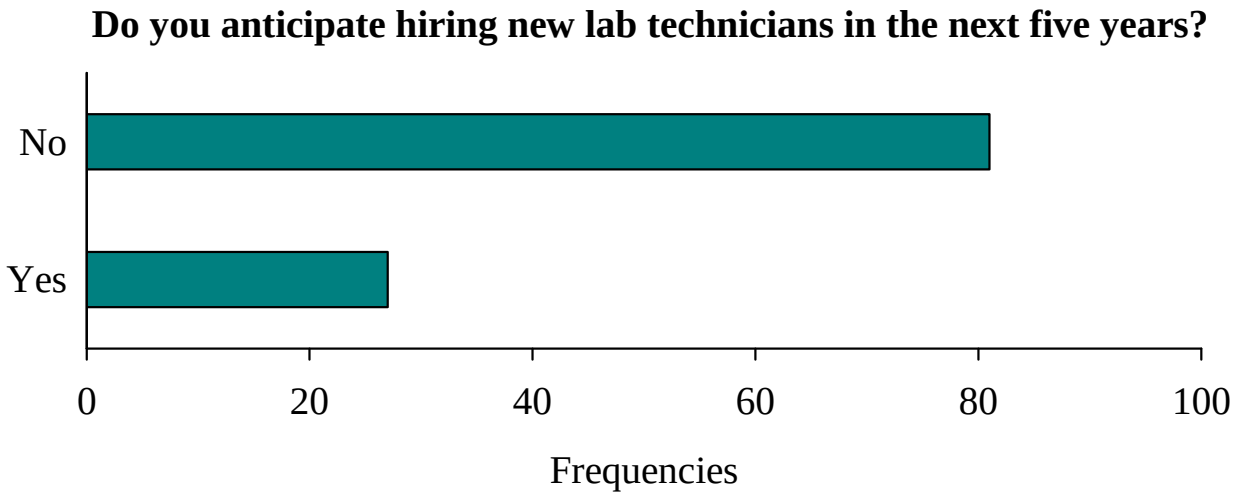

Figure 13. Hiring projection for Lab Technicians

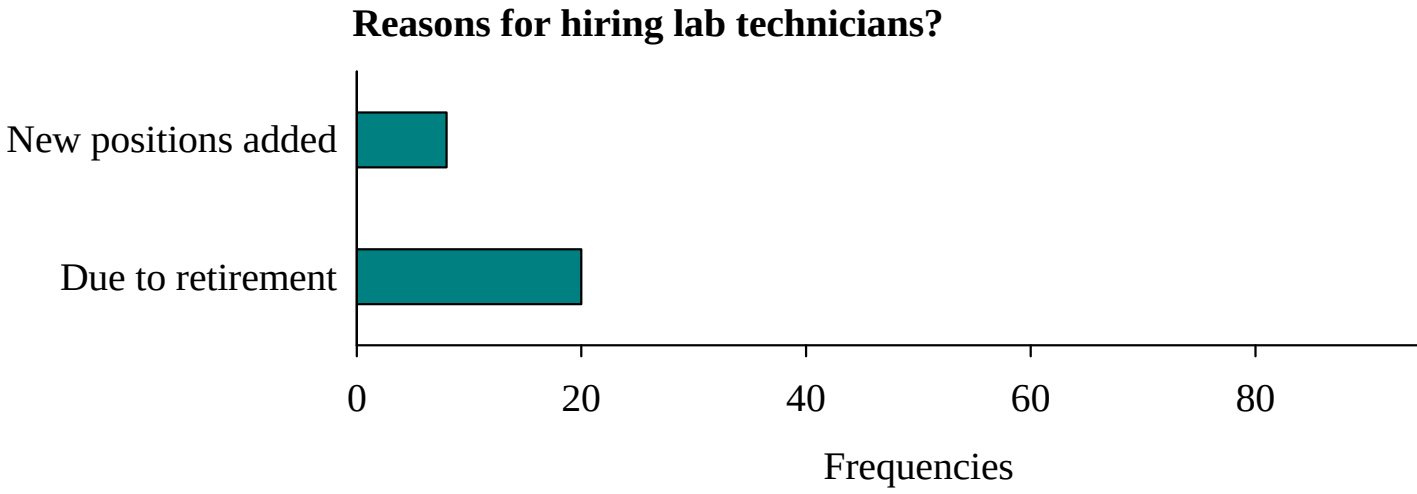

Figure 14. Reasons for hiring Lab Technicians

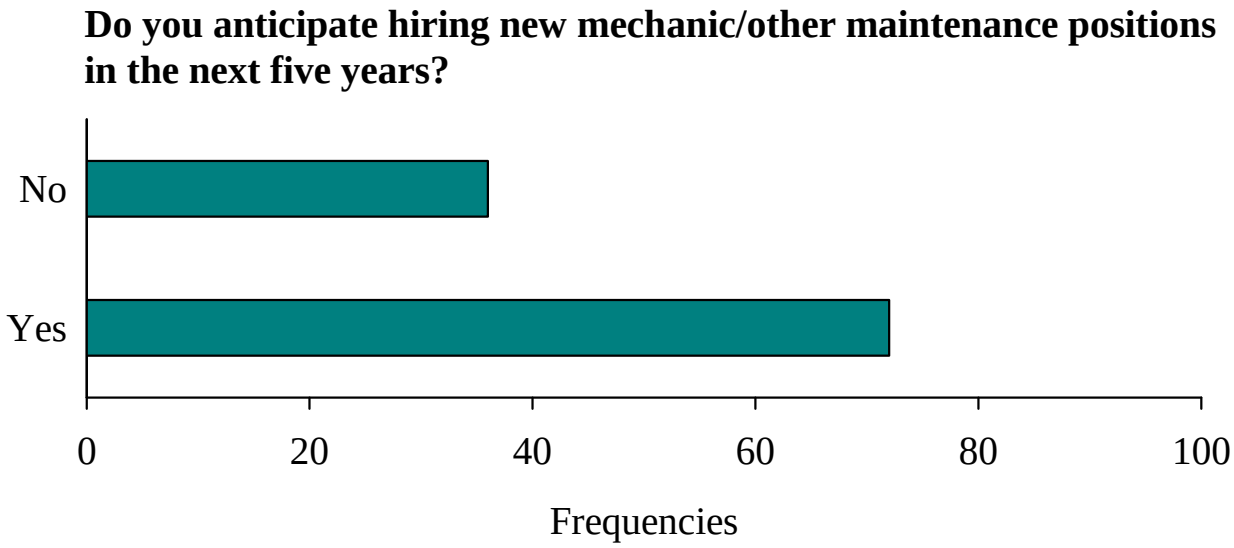

Figure 15. Hiring projection for Mechanic/Other Maintenance Position

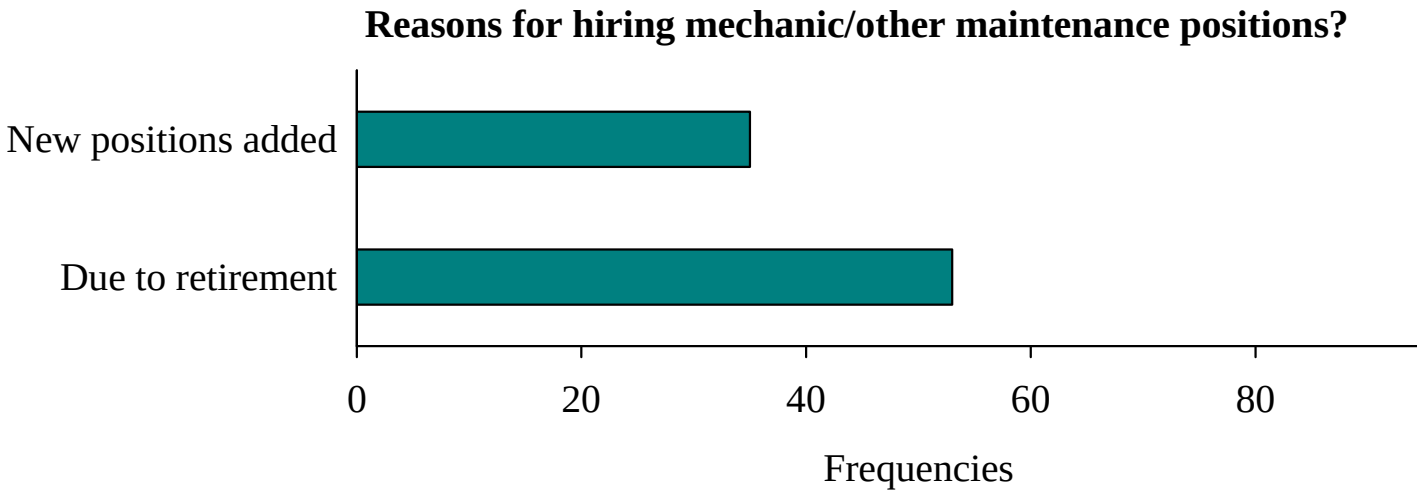

Figure 16. Reasons for hiring Mechanic/Other Maintenance Position

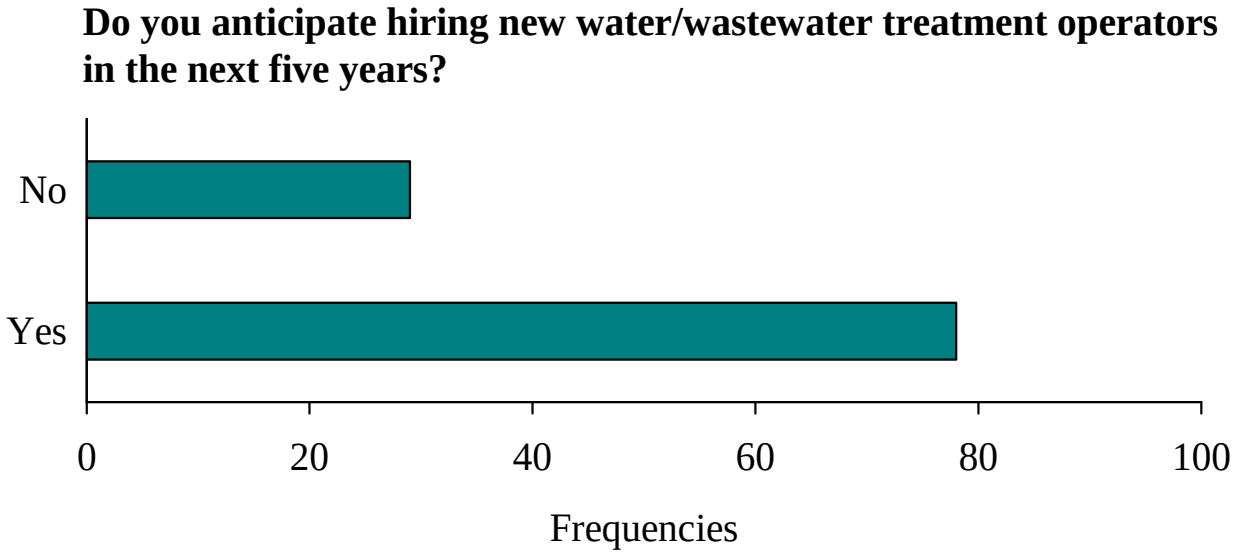

Figure 17. Hiring projection for Water/Wastewater Treatment Operators

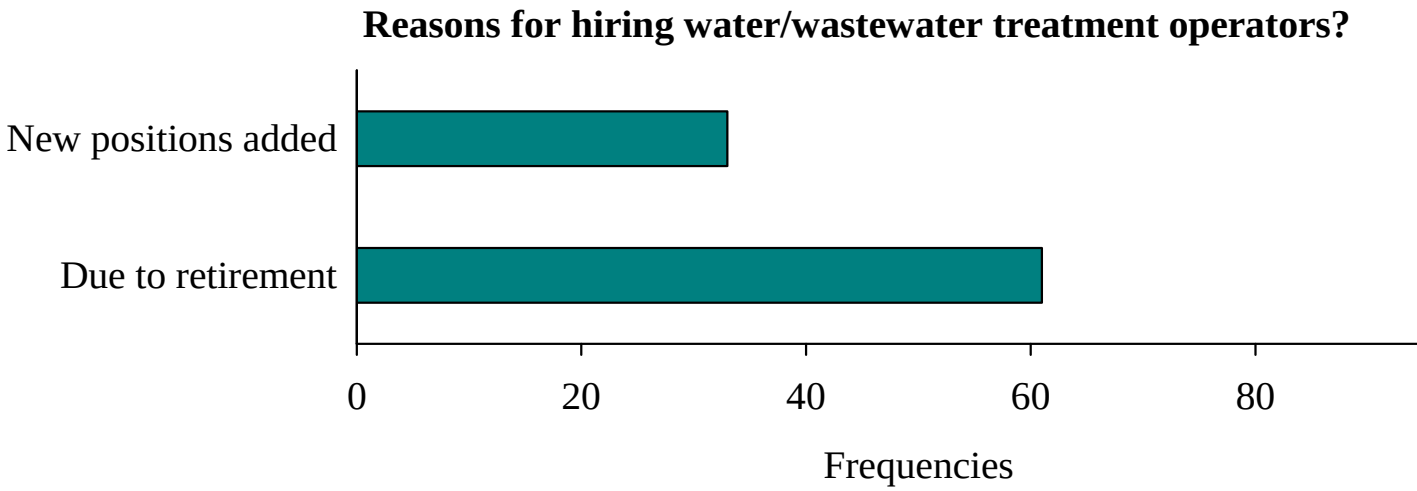

Figure 18. Reasons for hiring Water/Wastewater Treatment Operators

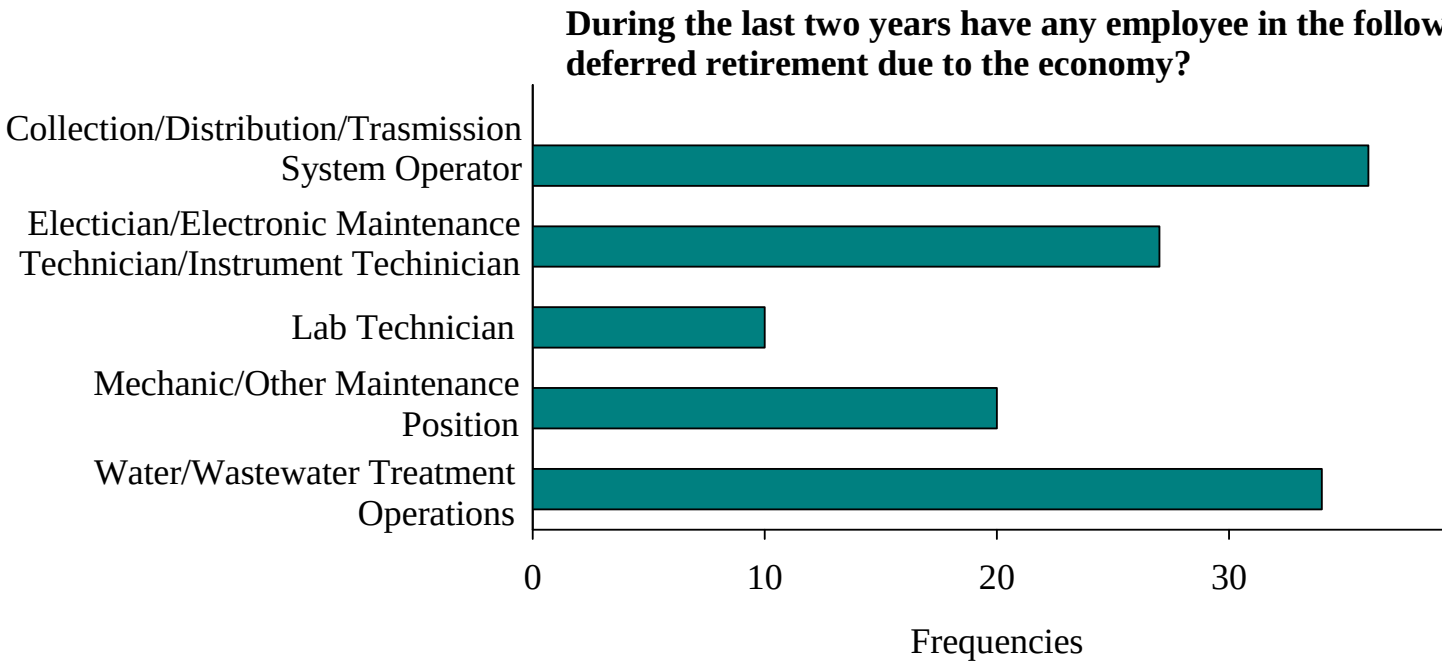

Figure 19. Influence of the economy in retirement projections

During the last two years have you delayed filling any of the following positions due to lower revenew projections?

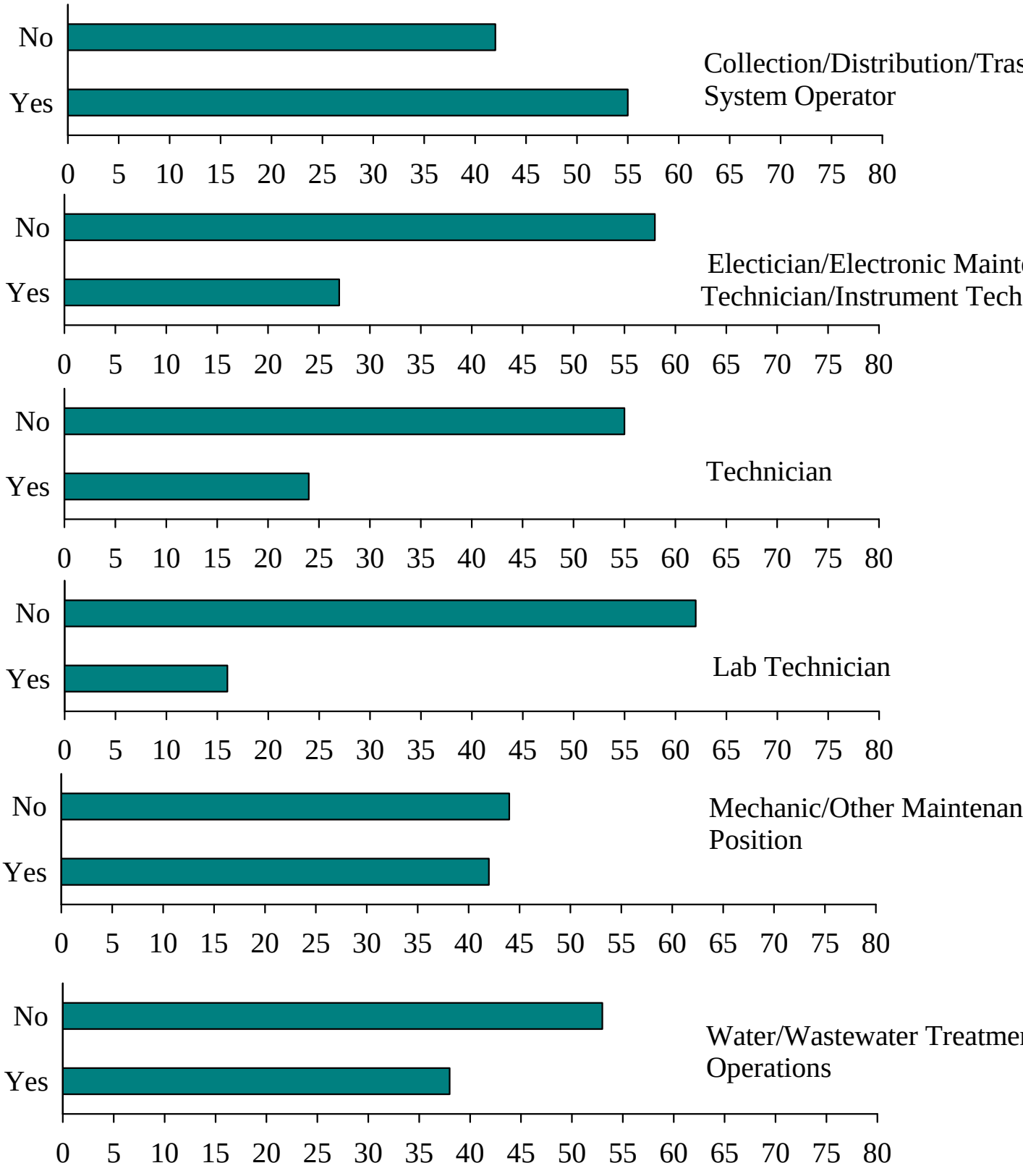

Figure 20. Influence of the economy in hiring planning

Apprenticeship and Internship Programs

In the Banner Center survey of 2010 eight apprenticeship programs emerged as the best sector wide initiative to help closing the gap in the water industry. From the results of this survey it is shown that 84.3% of the utilities do not have a registered program (Figure 21). Also for 12 utilities out of 18 apprenticeship programs are not the main source to hire trained operators (Figure 22). The utilities were asked to list the barriers to implementing apprenticeship programs. From Figure 23 it emerges that the lack of staff to supervise the programs as well as the lack of curriculum and prohibitive costs are seen as barriers. For few utilities the insurance or workers compensation as well as the age restrictions are considered barriers for this initiative. Among the other impediments or difficulties listed by the utilities there were the small size (that is related to lack of staff and costs) or the management that does not value this initiative. Other utilities do not see the need for these programs having enough already trained applicants to positions.

Some of the utilities showed a lack of knowledge on the requirements to start this program. Other utilities had an apprenticeship program in the past and think it is not needed now or did not benefit from it at the time.
As for internship programs for operators, 70% of the responding utilities do not have one (Figure 24).

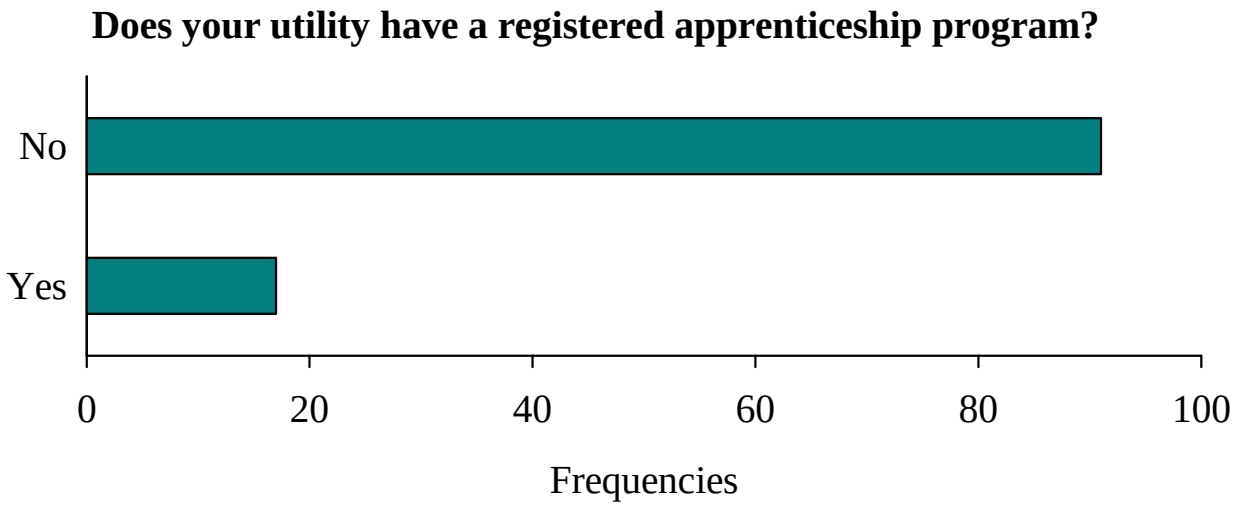

Figure 21. Apprenticeship programs at respondent utilities

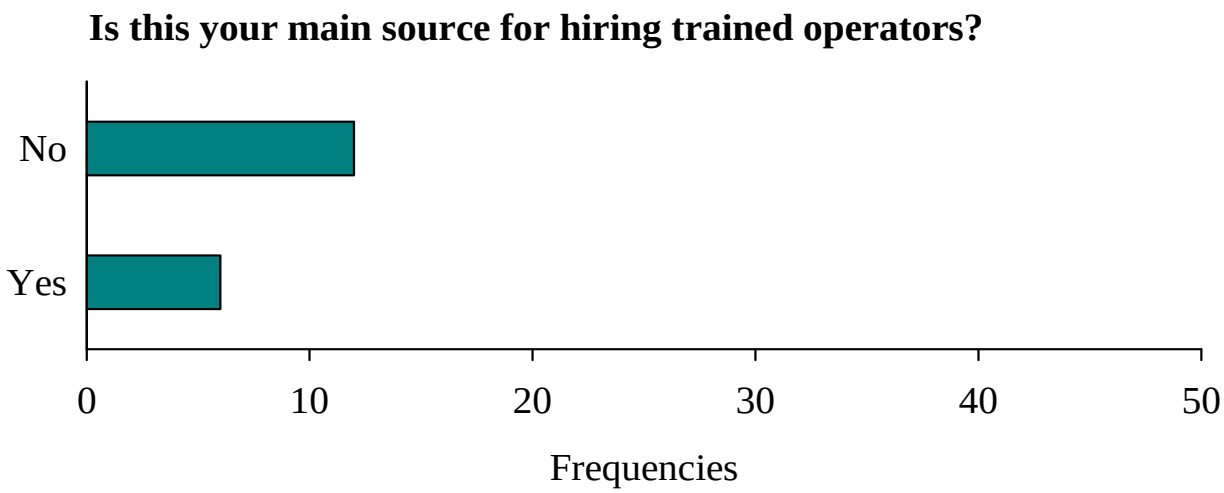

Figure 22. Utility Sources for hiring trained operators

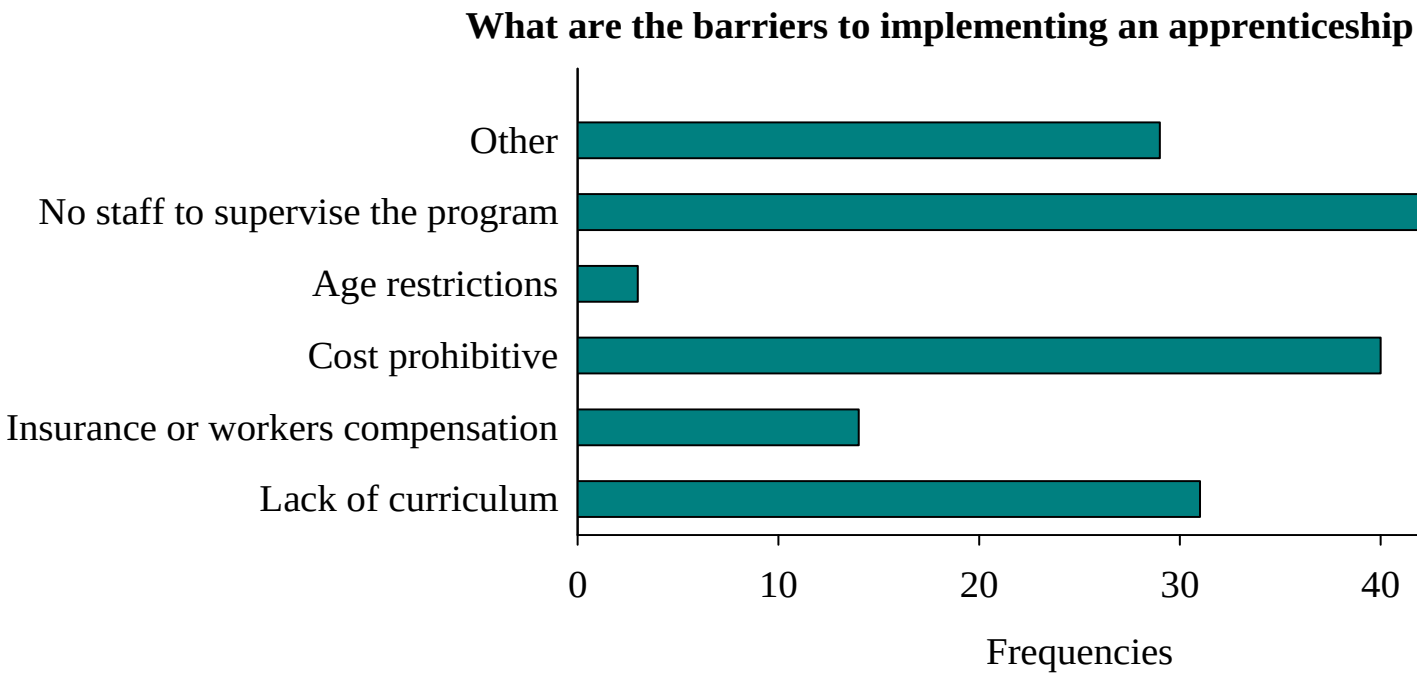

Figure 23. Barriers to implementing apprenticeship programs

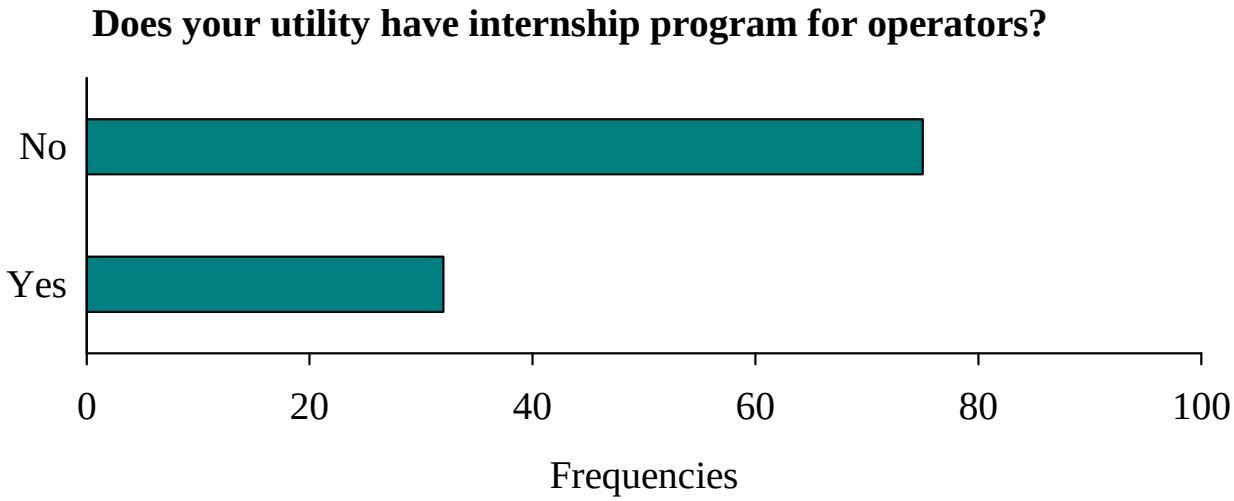

Figure 24. Internship programs at respondent utilities

Hiring Policy for Ex-offenders

This survey investigates the potential that ex-offenders have in filling the workforce needs in the water industry. The majority of the utilities, 60% do not hire ex-offenders, but 41 of 102 responding utilities do hire ex-offenders (Figure 25). When hiring ex-offenders, only 30% of the utilities require operator licenses (Figure 26). In terms of retention rate of ex-offenders compared to non-ex-offenders, the 70% of the utilities expressed no difference (Figure 27).

The utilities were also asked to list the challenges to hiring ex-offenders. Few utilities (six out of 59) do not see any challenge. For the rest, the main challenges noted include, reliability, trust, public relations, and security issues (26 utilities). For few utilities (seven) it depends on the nature of the offense and the nature of the position. For some utilities it is against the management/human resources policy to hire ex-offenders. Some utilities reported non-satisfactory past experiences. Others had limited experience with this situation. Some other utilities express the fact that there are sufficient non-ex-offenders applicants. The lack of driver license is mentioned by one utility as a challenge. Only one utility mentioned that holding an operator license can definitely help. The fact that utility crosses multiple counties that could result in violation of terms of probation was listed by one utility. One utility mentioned a past experience rated above satisfactory.

The utilities were also asked if the Banner Center could offer any assistance in the future to encourage hiring ex-offenders. Only few utilities proposed to offer training and certify ex-offender as well as provide a list of certified ex-offenders to the utilities. A proposed initiative from one utility is to provide initial trial funding for a period of one to six months.

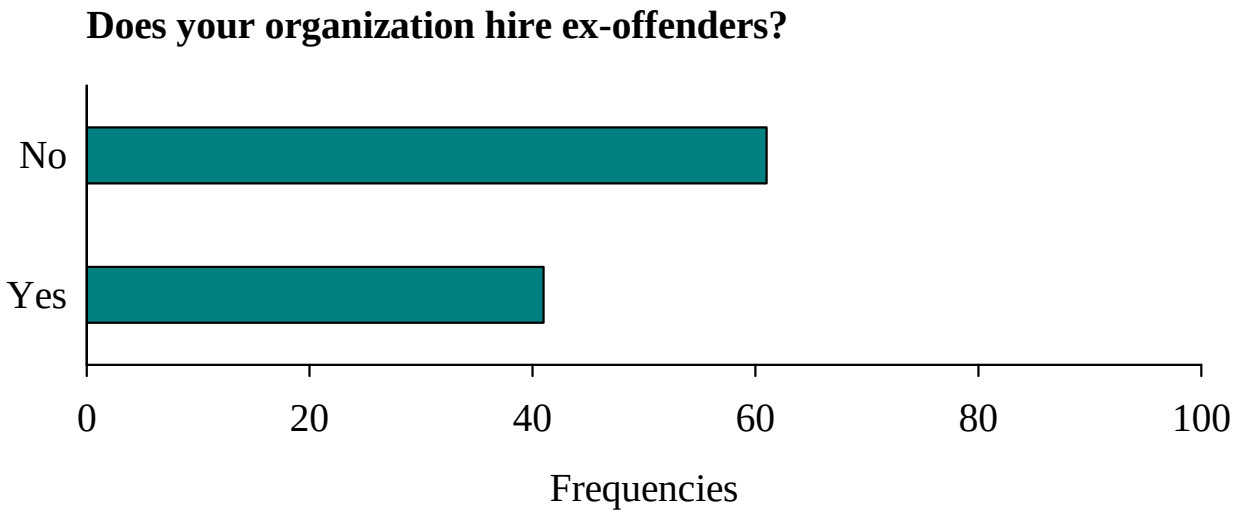

Figure 25. Hiring policy for ex-offenders at respondent utilities

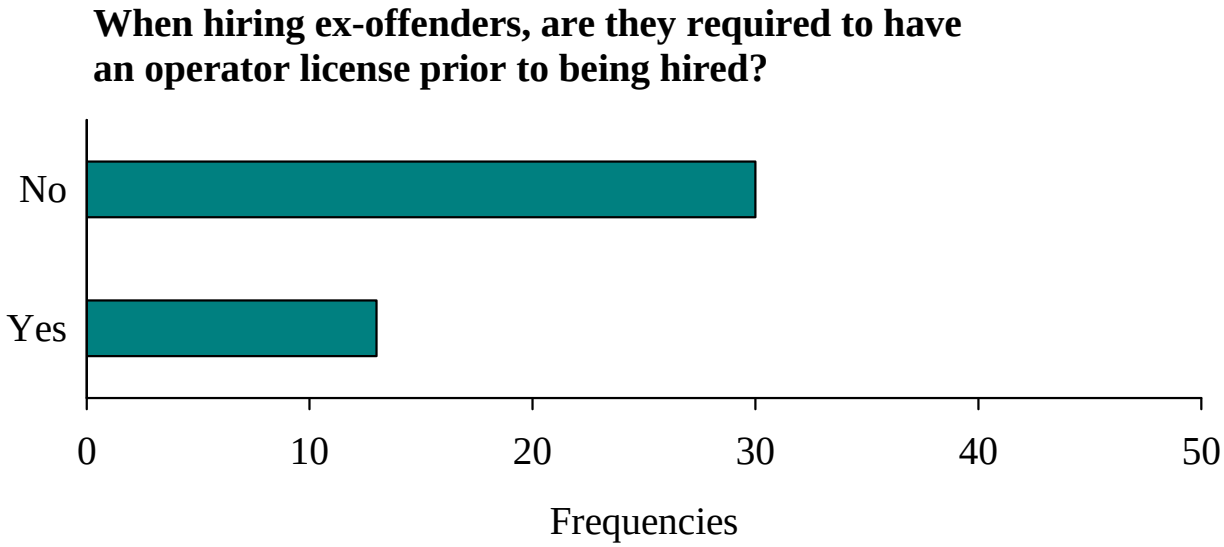

Figure 26. Licenses requirement in hiring ex-offenders

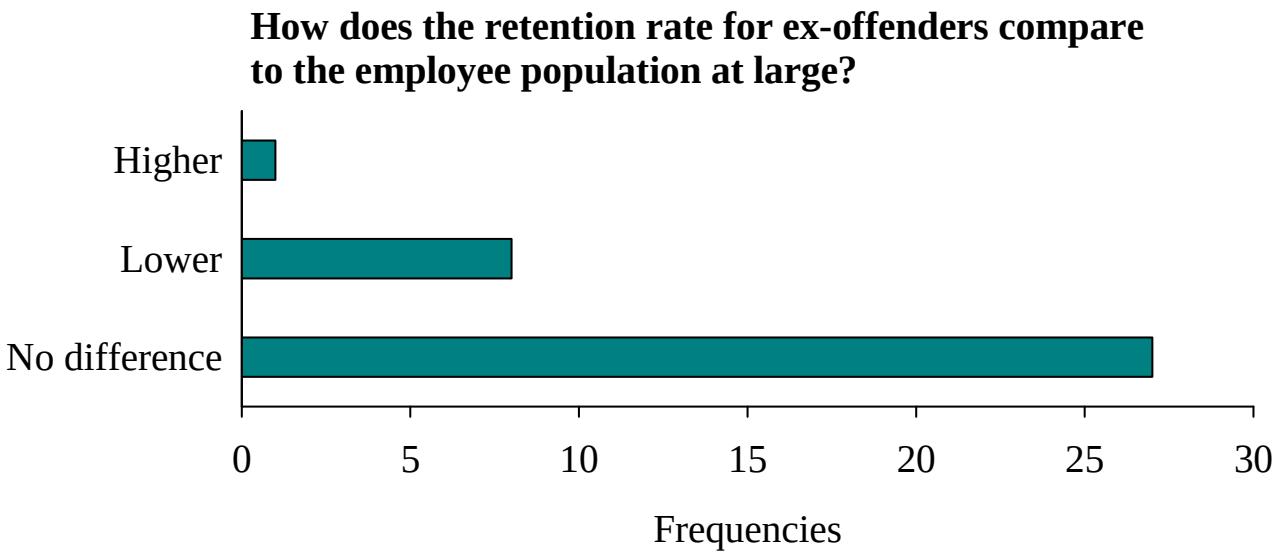

Figure 27. Retention rate for ex-offenders

FUTURE CHALLENGES IN THE WATER SECTOR

In this section three future challenges that will impact the water industry in the years in terms also of occupation are reported and ongoing projects in Florida are highlighted. In particular the increasing population growth and water demand, the consequent increasing urbanization and stormwater control for the protection of water bodies and the emerging pollutants are discussed in detail.

Population growth and water demand

The main future challenge in the water industry is the increasing population growth in Florida and the consequent water demand and wastewater treatment with more rigorous regulatory requirements for drinking water, wastewater effluent and stormwater discharges. Florida population in millions is reported in Figure 28 from 1900 to 2010 with a projection for population growth until 2030 (Census Bureau Data).

In a 2009 study of the U.S. Geological Survey on water use and trends in Florida in 2005 (*9*) it was reported that between 1950 and 2005, the population of Florida increased by 15.15 million (550 %), and the total water withdrawals (fresh and saline) increased 15,700 Mgal/d (600 %).

Between 1990 and 2005, saline-water withdrawals increased 1,120 Mgal/d (million gallons per day) (11 %), whereas between 2000 and 2005, they decreased 470 Mgal/d (4 %). Between 1990 and 2005, freshwater withdrawals decreased 710 Mgal/d (9 %), whereas between 2000 and 2005, they decreased 1,320 Mgal/d (16 %).

The use of highly mineralized groundwater as a source of supply, primarily for public supply, also has increased in Florida. This water, referred to as non-potable water, increased from just less than 2 Mgal/d in 1970, to 142 Mgal/d in 2005. Non-potable water is treated to meet drinking-water standards and is mostly used along the east and west coasts of central and south Florida.

It is noticeable that the use of reclaimed wastewater increased from 206 Mgal/d in 1986 to nearly 660 Mgal/d in 2005. About one-half of the reclaimed wastewater flow in 2005 was used to reduce potable-quality water withdrawals for urban irrigation, agricultural irrigation, and industrial use, but one-third of the reclaimed wastewater was returned to available water supplies as aquifer recharge.

Water re-use is increasing and it is interesting to observe the creation of initiatives like the South Tampa Area Reclaim (STAR) Project (*10*). It is an innovative approach to reduce the City of Tampa's potable water demands by using the high quality reclaimed water from the Howard F.

Curren Advanced Wastewater Treatment Plant (AWTP) to satisfy the water demands of high-volume irrigation users in South Tampa. After two summers of drought the City recognized the opportunity to conserve its valuable and limited potable water resources by expanding the existing reclaimed water systems.

The reclaimed water produced at the plant meets criteria established by the Florida Department of Environmental Protection (FDEP) for public access reuse for irrigation, as well as, for other non-potable uses. The AWTP currently receives and treats an annual average flow of approximately 55 – 60 million gallons per day (MGD). Much of this treated wastewater was at the time discharged to Hillsborough Bay through a permit from FDEP.

The City had existing reclaimed water systems that used approximately 2 MGD for irrigation and cooling, which is a small fraction of the reclaimed water produced.

In 1999, the STAR project evolved into a team effort between the Water Department and the City's Wastewater Department. This joint venture completed several preliminary design efforts, including a financial feasibility analysis and a preliminary route study. Both departments have received favorable response from the public to the project through neighborhood meetings, communication with civic associations, and a public opinion survey. Very clear information are available on the City of Tampa website with a brochure and frequently asked questions. The price for a unit of reclaimed water consisting in 748 gallons is $1.20.

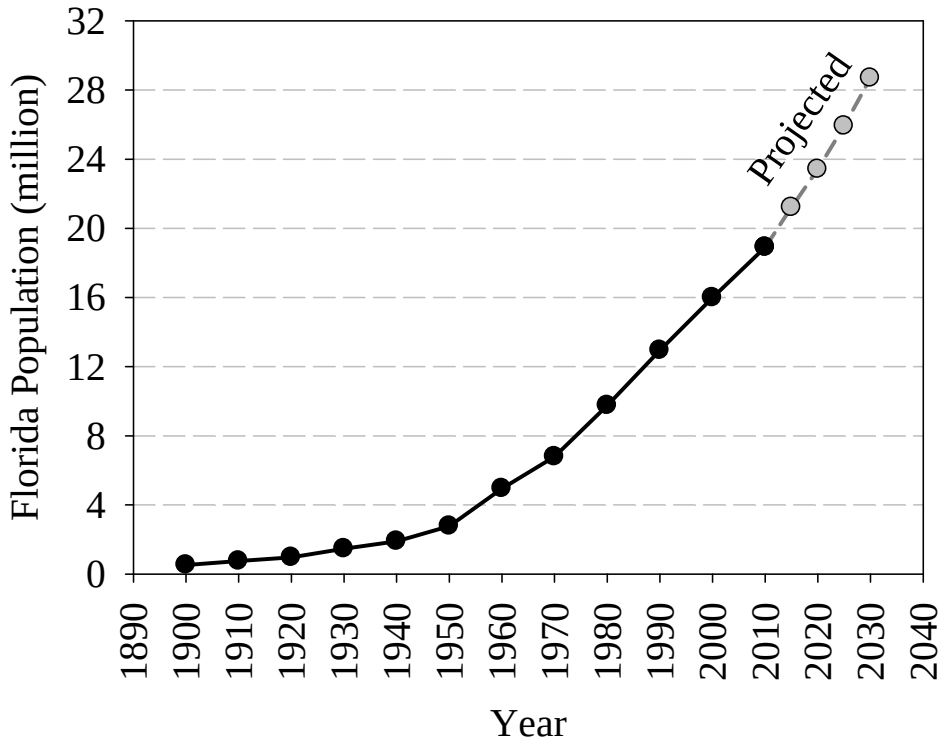

Figure 28. Population growth in Florida (U.S. Census Bureau)

Impacts of rainfall-runoff control and treatment on workforce needs

Since the passage of the 1972 Clean Water Act, control and treatment of rainfall-runoff (storm water) discharges became the most recent water treatment and reuse challenge (*11*).

As a consequence of population growth, urbanization has increased. In 1965, 1.2 million acres of land in the State of Florida were urbanized. By 1997 more than 5 million acres of land had been converted for urban use (Figure 29). Between 2000 and 2020 other 2.6 million acres of land are expected to become impervious urbanized areas (*12*). With urbanization, stormwater control became an issue in terms of quantity and quality. Stormwater runoff discharges from the urban environment have been identified as one of the major causes of quality deterioration in receiving water bodies. Rainfall-runoff from urbanized areas transports significant loads of particulate solids, metals, nutrients, pathogens, as well as inorganic and organic compounds. Loads and concentrations of these constituents are significantly above ambient background levels and, for many land uses, can exceed surface water discharge criteria on an event or long-term basis.

Since the National Pollutant Discharge Elimination System (NPDES) Stormwater Phase I permitting regulations in the 1980s, there has been a proliferation of stormwater control systems, including the Best Management Practices (BMP). However, experience over the last decade has demonstrated that there continues to be a significant gap in knowledge between BMP design/analysis/monitoring and the hydrologic, physical, and chemical processes in rainfall-runoff loadings. Such knowledge is critical to the success of a new generation of control strategies, BMPs, sustainable urban development (SUD) or low impact development (LID) concepts that will develop in response to ecological, environmental, and regulatory conditions, for example, the recent Phase II Storm Water Final Rule. The future challenge is to control storm water runoff while restoring the pre-development/urbanization hydrology.

Why monitoring and controlling stormwater is more challenging compared to wastewater or drinking water? First of all there is lack of knowledge of the pollutants that need to be targeted in stormwater runoff and the nature of these constituents is site specific and secondly the volume that requires control and treatment is unknown depending on rainfall events, catchment characteristics, land use, anthropogenic activities (like vehicular traffic), pollutant transport process and nature of pollutants (dissolved or bound to particles). Flow and loading variability in rainfall runoff can change by orders of magnitude during an event.

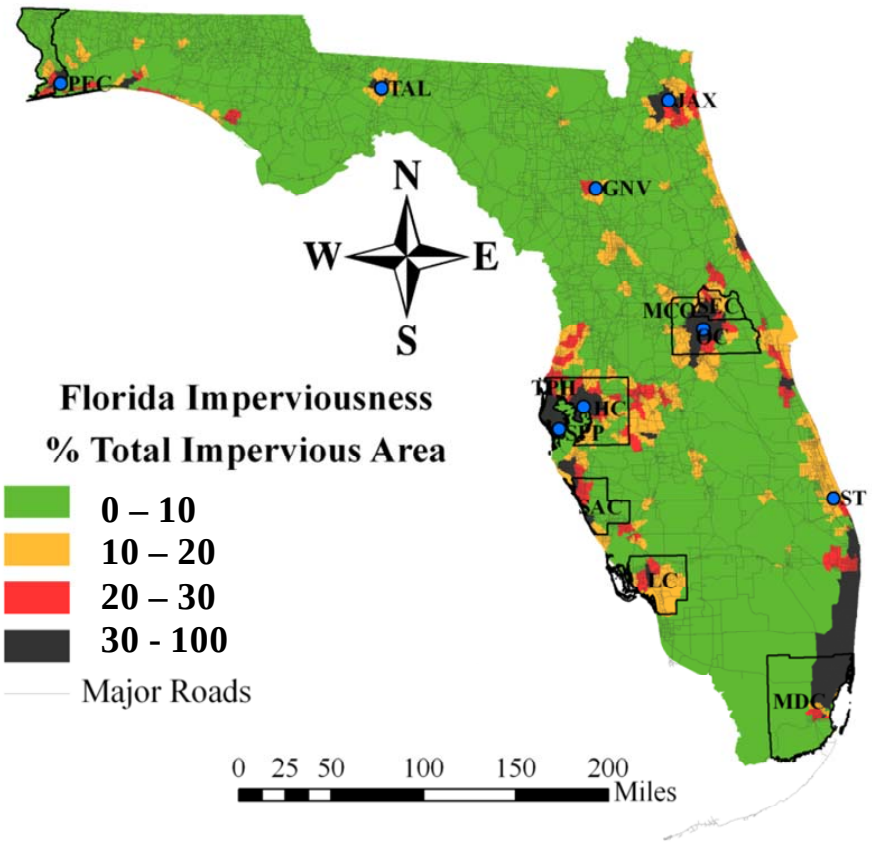

Figure 29 % Total Impervious Area for the State of Florida

Structural rainfall runoff treatment systems are needed and will become a permanent component of rainfall-runoff treatment, control, and reuse, but structural solutions alone are not economically sustainable and often difficult to realize. Source control must be an integral part of rainfall-runoff treatment, control, and reuse. Non-structural solutions like street sweeping, catch basin cleaning can provide a great source control. Also regular maintenance of existing BMPs has to be included in the operations for stormwater control.

In Florida new restrictive regulations will impact the future of the water management industry. In particular great attention has been given to nutrients. The U.S EPA's Final Rule for Numeric Criteria for Nitrogen/Phosphorus Pollution in Florida's Inland Surface Fresh Waters (*13*) poses big challenge for the stormwater and waste water sector. Stormwater and wastewater discharges are at the moment one order of magnitude higher than some of the criteria for lakes, springs and streams. In the future source control and more efficient treatment solutions will need to be implemented with a projected need of researchers, civil and environmental engineers, lab technicians, maintenance positions and treatment operators.

Phosphorus (P) is a limiting nutrient and is considered a major constituent of concern for the ecological health of surface and groundwater. Urban anthropogenic activities and urban design practices within the built environments, such as the proliferation of imperviousness, significantly increase nutrient inputs such that eutrophication is now regarded as a significant stressor to inland and coastal ecosystem health

In a recent study sponsored by the Florida Department of Environmental Protection (FDEP) (*14*, *15*), Berretta and Sansalone showed the high concentration of phosphorus in rainfall runoff from a landscaped parking lot at the University of Florida. A mean total phosphorus concentration of 3.6 mg/L resulted from 15 monitored rainfall events. Phosphorus in the urban environment resulted to be mainly bound to particulate matter while 30% is in dissolved form. By analyzing the dissolved form, that requires more advanced treatment systems, it resulted that more of the 90% of dissolved phosphorus consist of orthophosphates, which are the most direct bioavailable form for algae.

As an example of conjunct effort for stormwater source control, in 2010 the Department of Environmental Engineering Sciences (EES) of the University of Florida conducted a study sponsored by the Florida Stormwater Association Educational Foundation (FSAEF) and the Florida Department of Environmental Protection (FDEP) to quantify the nutrient loads associated with urban particulate matter and biogenic/litter recovery through maintenance practices of stormwater management systems (*16*).

This knowledge represents a defensible foundation to build the allocation of stormwater load reduction credits for maintenance practices. These maintenance practices remove particulate matter (PM) from the urban inventory of solids that are transported and stored in stormwater management systems. Importantly, this particulate matter contains nutrients (and other constituents, like metals) that result from the interaction and imposition of anthropogenic activities and urban infrastructure design practices/materials on the hydrologic cycle. Particulate Matter samples were collected from fourteen MS4s (municipal separate storm sewer systems) across Florida (Gainesville, Hillsborough County, Jacksonville, Lee County, Miami-Dade County, Orange County, Orlando, Pensacola/Escambia County, Sarasota County, Seminole County, St. Petersburg/Pinellas County, Stuart, Tallahassee, Tampa), from three different maintenance practices, in particular, street sweeping, catch basins cleaning, and BMPs maintenance, and in three independent locations in areas characterized by different land uses (commercial, residential and highways) for a total of 27 particulate samples per MS4. Three of these MS4s collected another set of 27 samples in areas characterized by the use of reclaimed wastewater. The samples were analyzed for nutrients, total phosphorus and nitrogen to measure for Florida the amount of nutrients removed by removing particles through maintenance practices.

In the Florida Stormwater Association 2011 Stormwater Utilities Survey is reported that there are 154 local governments that have established stormwater utilities pursuant to Chapter 403, Florida Statutes or their own home rule powers. The number of stormwater utilities is expected to continue to increase for several reasons: The Florida Supreme Court has consistently upheld the validity of stormwater fees; there is more public support for funding programs with users' fees as opposed to ad valorem or other general taxes; the process of implementing the multi-billion dollar Total Maximum Daily Loads (TMDL) program in Florida that is now beginning to take full effect.

Eighty-one utilities responded to the survey. The highest percentage of the total stormwater program's annual budget is allocated to the Operation and Maintenance (Field Activities) Personnel.

In this framework rainfall runoff control has an important future as an environmental discipline, as a research direction, and as an industry. As an industry, the market for rainfall-runoff treatment systems is doubling every three to four years and is currently a $100+ million treatment industry. Rainfall-runoff treatment, control, and reuse will become the environmental industry of this century in the U.S.

There will be a need for researchers, engineers, and operators in the stormwater industry and new curricula need to be implemented to address this new challenge. The technological skills of the workforce in the overall urban water sector will have to be upgraded through education and training, so new courses and training programs need to be developed.

Impacts of Emerging Pollutants on Workforce Needs

Emerging pollutants are pollutants that have been recently discovered in the environment such as endocrinal disruptors resulting of some organic compounds degradation or introduction of medicine in the natural environment (*17*). Emerging Contaminants are suspected of causing adverse effects in humans and wildlife. Active hormonal substances are being widely used in human and veterinary medicine such as estrogens, anti-inflammatory cortico-steroids and anabolic androgens.

Surface water contaminated by municipal and industrial sources, and diffuse pollution sources from urban and agricultural areas continue to build up pollution levels in the environment. Numerous field studies, designed to provide basic scientific information related to the occurrence and potential transport of contaminants in the environment are being continuously conducted with the aim to identify which contaminants enter the environment, at what concentrations, and in what combinations. A large body of literature exists on occurrence of specific groups of

organic contaminants in the environment. However, in the past research priorities have focused on priority pollutants, such as POPs, pesticides, toxic metals, radionuclides. Only recently, the attention of the scientific community has started to shift to emerging contaminants. Therefore, a major challenge will be to identify the chemicals which potentially will become dangerous in the future. It has to be cleared if it is sufficient to look (just) for persistent, high flux, toxic, endocrine active compounds.

The major sources of environmentally relevant emerging contaminants are primarily wastewater treatment plants effluents, and secondarily terrestrial run-offs (roofs, pavement, roads, agricultural land) including atmospheric deposition. Characteristic of some contaminants is that they do not need to be persistent in the environment to cause negative effects since their high transformation/removal rate is compensated by their continuous introduction into the environment. For most of the occurring emerging contaminants, risk assessment and ecotoxicological data are not available and therefore it is difficult to predict which health effects they may have on humans, terrestrial and aquatic organisms, and ecosystems. Also the budgets (sources, entry routes, and fate) for environmental pollutants would be of importance. Table. 6 summarizes the data regarding the occurrence of several emerging contaminants in the environment.

Table 6. Selected emerging contaminants.

Compound	**Origin**	**Persistence Bioaccumulation**	**Observed in environment**
Nonylphenol	Degradation product of non ionic surfactants	Medium persistent Bioaccumulative	Soil Sediment Sludge Water
Bisphenol A	Plastics	Not bioaccumulative	Surface water Groundwater
Phthalates	Plastics	Low to medium persistent atmospheric deposition	Water Sediment Sludge
PBDE	Flame retardant	Persistent/highly accumulative atmospheric deposition	Sediment Soil Sludge
C_{10}-C_{13} chloroalkanes	Flame retardant	Persistent/ bioaccumulative	Surface water
Sulphonamides	Human and veterinary drug	Slightly-very persistent	Groundwater
Tetracyclines	Human and veterinary drug	Moderately-very persistent	Groundwater Soil Sludge
Steroid sex hormones	Contraceptives	Moderately persistent	Water Sediment Sludge

MTBE	Gasoline additive	Persistent Not bioaccumulative - but ubiquitous in the atmosphere	Groundwater

In Florida in 2004 the U.S. Geological Survey, in cooperation with the Comprehensive Everglades Restoration Plan Wastewater Reuse Technology Pilot Project Delivery Team, initiated a study to assess the presence of emerging contaminants of concern in the South District Wastewater Treatment Plant influent and effluent using current wastewater-treatment methods (*18*).

The Comprehensive Everglades Restoration Plan has identified highly treated wastewater as a possible water source for the restoration of natural water flows and hydroperiods in selected coastal areas, including the Biscayne Bay coastal wetlands. One potential source of reclaimed wastewater for the Biscayne Bay coastal wetlands is the effluent from the South District Wastewater Treatment Plant in southern Miami-Dade County. Samples were tested for detection of household and industrial (organic) wastewater compounds, pharmaceutical compounds, antibiotic compounds, and hormones in influent. Two "known" endocrine disrupting compounds (17 beta-estradiol (E2) and diethoxynonylphenol) and four "suspected" endocrine-disrupting compounds(1,4-dichlorobenzene, benzophenone, tris(2-chloroethyl) phosphate, and tris(dichloroisopropyl) phosphate) were detected during these sampling events. Phenanthrene and indole showed the greatest concentration ranges and highest concentrations for the organic wastewater compounds. Acetaminophen showed the greatest concentration range and highest concentration, and warfarin showed the smallest concentration range for the pharmaceutical compounds. Sulfamethoxazole (a sulfonamide) showed the greatest concentration range and highest concentration, and sulfathiozole (also a sulfonamide) showed the smallest concentration range for the antibiotic compounds. Two hormones, 17 beta-estradiol (E2) and estrone (E1), were detected in influent. Samples were also tested for detection of organic wastewater compounds, pharmaceutical compounds, antibiotic compounds, and hormones in effluent. Indole showed the greatest concentration range and highest concentration, and triphenyl phosphate showed the smallest concentration range for the organic wastewater compounds. Dehydronifedipine showed the greatest concentration range and highest concentration, and warfarin had the smallest concentration range for the pharmaceutical compounds. Anhydro-erythromycin (a macrolide degradation product) showed the greatest concentration range, and sulfadiazine (a sulfonamide) and tetracycline showed the lowest concentration ranges for the antibiotic compounds. One hormone, 17 beta-estradiol (E2), was detected in effluent.

More advanced targeted treatment will be needed in order to meet new criteria for water bodies and for drinking water and control emerging pollutants. The necessity for advanced water and wastewater treatment such as membranes and ultraviolet disinfection to respond to regulatory requirements will require upgraded technological skills of the workforce. Education and training

programs that include these technologies and emerging pollutants knowledge need to be developed. It is projected there will be a need for researchers, civil and environmental engineers, lab technicians, maintenance positions and treatment operators.

Furthermore, in the next years, due to the new regulations on water quality, stormwater control and emerging pollutants, there will be an increasing effort in monitoring programs. Monitoring discharges from urban environment or industrial sites as well as water bodies' quality will be the instrument to address current issues as well as control new treatments and initiatives' efficiency.

CONCLUSIONS

This study investigated the workforce needs in Florida in the water industry sector by reviewing previous studies, analyzing statistics and projections, conducting a survey that reached 116 utilities and by looking at the future challenges that will impact the water industry in the coming years.

Findings of this study revealed that the demand of operators in the category Water and Liquid Waste Treatment Plant and System Operators in Florida is projected to increase significantly in the next 7 years with an increase rate of 130 jobs per year. In the field of water this job category together with civil engineers are considered among the fastest growing occupations.

By observing the actual workforce in the state of Florida, and in particular the category of operators in the water industry it emerges that the average age of active and inactive drinking water and wastewater license holders in 2007 was 50 years while in 2011 is 51. In 2011 almost 40% of the license holders are in the 51- 60 years range with 30% in the range 41 - 50 years. The results of this study also show the small percentage of operators younger than 30 years.
In the last two license cycles from 2007 it is promising to observe that the number of new licenses issued is higher if compared with the operators leaving the profession.

From the data of the State of Florida Department of Education it emerges that the enrollment in technical programs for operators is very low and has decreased significantly in the last years from 2003.

Findings of the survey showed that the top three required occupations in the next 5 years are the following: Collection/Distribution/Transmission System Operator, Water/Wastewater Treatment Operators and Mechanic/Other Maintenance Position. The main reason for future hiring is the retirement of the actual employees and not the need for new positions. The employees in these three categories chose to defer their retirement due to the recession period.

The majority of the utilities responding to the survey do not have apprenticeship and internship programs. It emerged that the lack of staff to supervise the programs as well as the lack of curriculum and prohibitive costs are seen as the major barriers for developing these programs.

This survey investigated the potential ex-offenders have in filling the workforce need in the water industry. The results show that the majority of the utilities do not hire ex-offenders. The main challenges in hiring them were the reliability, trust, the need to work in contact with public and security issues.

A future need of researchers, engineers, and operators is projected in Florida to address the increasing population growth and water demand, the consequent increasing urbanization and stormwater control for the protection of water bodies, also according to the new regulations, and the emerging pollutants.

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