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A Content Validity Study of the Water Training Institute Curriculum

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A CONTENT VALIDITY STUDY OF THE WATER TRAINING INSTITUTE
CURRICULUM

A Thesis
Presented to
The Faculty of the Department of Psychology
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Masters of Industrial/Organizational Psychology

By
Alicia Turner
May, 2010

A CONTENT VALIDITY STUDY OF THE WATER TRAINING INSTITUTE
CURRICULUM

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101 Pages

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Content validity methods, such as matching matrices, have been used to assist in the design and evaluation of training programs. In the present study, the Water Training Institute (WTI) curriculum was evaluated using a content validation approach. The purpose of the study was to identify topics that were being under-emphasized, over-emphasized, or receiving the correct amount of emphasis in the curriculum. A Job Knowledge Survey was developed and administered to subject matter experts to determine the importance of topics to the jobs that WTI graduates would most likely enter after graduation; the importance ratings were used as the criterion for the study. Subject matter experts in a Course Content Workshop indicated the amount of emphasis placed on each topic in four WTI courses. Matching matrices plotting job importance against course emphasis were created for each of the four target jobs for WTI graduates. These matrices did not identify any hits (i.e., topics receiving correct amount of emphasis). However, there were a number of deficiencies that were near hits. These findings will assist WTI in developing future courses and in redesigning their currently offered courses.

A CONTENT VALIDITY STUDY OF THE WATER TRAINING INSTITUTE CURRICULUM

Having clean and safe water is a necessity for individuals; it is the function of Water and Wastewater Technicians to provide society with the safe water that it needs. Yet, the Water and Wastewater Industry is expected to be greatly affected by the retirement of the 'Baby Boomers,' with as much as 50% of the workforce projected to retire in the next three to five years. In addition to this expected increase in retirement, the applicant pool for water and wastewater treatment jobs is small. This has become a concern for the Water and Wastewater Industry, as professionals in these positions are necessary to provide water services for an ever growing population. In fact, the number of technicians needed is expected to increase during the next seven years at an above average rate in comparison to governmental employment rates.

To combat this anticipated challenge, the Kentucky and Tennessee Water and Wastewater Industry has partnered with Bowling Green Community College (BGCC) in order to further develop the Water Training Institute (WTI). The National Science Foundation awarded a grant (Ernest, 2009) that will allow WTI to be developed, staffed, and advertised in the hopes of increasing the number of interested applicants and supplying the students with efficient training for jobs in the Water and Wastewater Industry. The goal is for the WTI program to be available nationally after development.

WTI will consist of a two year associate program with the potential for continuing into a four year program (of student's own academic choice). Additionally, two certificate programs (one specializing in water treatment and one in wastewater

treatment) will be available both for those students in the two year program and non-students. The curriculum for the WTI program will contain general education requirements, science requirements, and two specialized tracks in either water or wastewater treatment. The courses in the specialized tracks will teach the knowledge, skills, and abilities (KSAs) needed for an entry level position in the respective field. The WTI steering committee identified four projected jobs that graduate students will be most likely to enter: Water Treatment Operator, Wastewater Treatment Operator, Distribution Systems Operator, and Collection Systems Operator. Thus, the WTI curriculum must prepare students for entry into any of these jobs.

In order to ensure that the WTI curriculum does, in fact, prepare students to enter the identified jobs, a content validation study is needed. The current study will address this need through an assessment content validity study of the WTI program. The WTI program currently has four courses designed; however, additionally courses will be developed and implemented. While this study will focus only on the evaluation of the current courses, it is anticipated that an additional study will be conducted after the development of the remaining courses.

Content Validation

In order for a training program such as WTI to be effective, it is necessary that it is designed using scientific methods and that it is routinely evaluated (and redesigned if needed) to address changes in organization needs or to address design issues with the program. If these practices are not followed, the organization will likely have an ineffective program, which is unfortunate, as a poor training program is not only

inefficient but also costs the organization time and money. Additionally, such a program can have the adverse effect of lowering employee/student morale and productivity.

Taking these extra steps to ensure content validity will ultimately provide the organization with a more successful training program that will more likely accomplish the objectives of the organization.

One method used to evaluate the effectiveness of a training program is content validation. The content validity of a training program refers to the extent to which the material in the training course reflects the actual job material; the KSAs needed to perform the job effectively should be included in the program while those KSAs not needed in practice should not be taught. The more similar the training course is to the job, both in content and psychological fidelity, the more effective the course should be. Using content-oriented validity can offer several advantages over other methods such as criterion-oriented validity (Sproule, 2009). Whereas criterion-oriented validity may have sample size, range restriction, and/or criterion measurement issues, content-oriented validity does not suffer from these problems. Furthermore, as Sproule discussed, highly content valid measures usually have low adverse impact and high criterion-related validity. Thus, given its advantages, a content-oriented validation study was the most practical and efficient manner in which to analyze the validity of the WTI program.

There are several different methods available to use to conduct a content validity study for a training program. The most commonly used methods are the matching technique, linking, and a quantitative approach. Each of these methods is useful in its own right, but they are more useful when used in conjunction with each other.

Matching Technique

One of the most frequently cited methods for evaluating and redesigning training programs with regards to content validity was introduced by Ford and Wroten (1984) during their work with a police force. This method, the matching technique, compares the results from a training needs analysis with the current training program in order to evaluate and redesign the program. Ford and Wroten demonstrated their proposed technique through a two-part study with a large midwestern city police department. The first part of their study concerned the actual content of the training course; it was important that the content of the course be job related. To establish content validity, Ford and Wroten (1984) used subject matter experts (SMEs) to identify the true content domain of the KSAs that were currently taught in the training course. A survey was developed based on the KSA list; training staff members and police officers responded to the survey that asked whether each KSA was taught in the program. This provided a comprehensive list of the current content of the program.

The second step was to evaluate the job relatedness of the training content. Job incumbent SMEs were asked to rate the importance of each KSA to job performance. Ford and Wroten (1984) then calculated the Content Validity Ratio (CVR) for each KSA. The CVR is calculated by subtracting the number of experts who think the item is not important from the number of experts who think the item is important, and dividing that by the total number of experts. The calculated mean of all CVRs provided the Content Validity Index (CVI), which indicated the job relatedness of the entire training program. Ford and Wroten found that overall the training program had a high CVI; however, there were specific KSAs that had low CVRs. This finding led to the second study.

Based on the findings from the analysis and evaluation of the training program, Ford and Wroten (1984) used their matching technique to redesign the program. The matching technique uses a matrix that compares the training emphasis (how much time the program spends on the items) to the training needs (how important the item is to successful job performance).

This matrix provides two types of information: hits and misses. Hits are when the training emphasis reflects the training needs (i.e., an item with low importance will receive low emphasis in the program and an item with high importance will receive high emphasis in the program). A miss can indicate either a deficiency (i.e., high importance item receives low emphasis), or an excess (i.e., low importance item receives high emphasis). Once this technique is applied, it becomes evident if a program needs to be redesigned and, if so, specifically where and how to redesign the program. Ford and Wroten (1984) used an independent assessment by SMEs to determine the actual hours of class time spent on a task. Correlational analysis indicated a large number of hits; however, the matching technique was necessary to establish exactly where the misses occurred.

Linking Technique

While the matching technique can provide valuable information over using the CVR or CVI alone, researchers have proposed that linking the matching technique to other areas of training design can extend its effectiveness even further. Teachout, Segó, and Ford (1997) utilized such a method by linking the matching technique to both training effectiveness and training transfer. It is their suggestion that these additional pieces of information provide a more thorough understanding of the content validity and

evaluation of a training program. When applied correctly, the linking method should indicate the efficiency, transferability, and effectiveness of specific parts of the training. All of these elements would provide a more comprehensive analysis of the training program and would aid in redesign. These additions solve one of the problems with the matching technique, which is that certain items that are difficult or easy to learn may be taught for longer or shorter periods that may not correspond with their level of importance.

To demonstrate their linking method, Teachout et al. (1997) analyzed a technical training course for the United States Aerospace Ground Equipment. They randomly selected 33 tasks and reported on their training efficiency, transfer opportunity, and training effectiveness. The matching technique was used to provide information on the training efficiency of the tasks and courses by examining the time spent on a task compared to its reported level learning difficulty (this varies from the previously discussed matching technique which used importance as its criterion variable). The transfer opportunity variable was measured by the number of times the tasks had been performed on the job in the eight months since the training course. Finally, training effectiveness was measured using a performance rating from the trainee's supervisor eight months after the training.

The researchers found that although there were traditional misses indicated from the matching technique, these over-trained jobs were actually performed more frequently on the job and to a higher level of effectiveness. This indicates the importance of utilizing more than one technique when conducting a training analysis; while data may indicate a miss, in actuality, it may be more beneficial to the organization to leave that "miss" in the

course. However, caution must be used when interpreting these results. Teachout et al. (1997) suggested that tasks with a low transfer outcome (i.e., not performed on job) should be considered for elimination from the course. Although this may be a desirable outcome, it is necessary to take into account the importance of the task. Teachout et al. did not measure the importance of the tasks and, although a task may be performed infrequently, it may be a highly critical task that, when performed, must be done correctly.

Quantitative Approach

In addition to the matching and linking methods, Bownas, Bosshardt, and Donnelly (1985) developed a quantitative approach that would allow for statistical analysis of the matching and linking techniques. Bownas et al. examined the job requirements for a Coast Guard position; they collected data on whether the task was performed, how much time was spent, how critical it was to job performance, and how difficult it was to learn. They also examined the current training content to see if the task was trained and how much emphasis was placed on it during training (based on time spent covering the task). These variables were correlated to indicate the level of content validity for the training program. Additionally, Bownas et al. collected data on training effectiveness using performance ratings to provide a more comprehensive view.

Bownas et al. (1985) used SMEs to review existing job tasks and rate them on the previously identified criteria. SMEs then completed a questionnaire that indicated the extent to which the training content developed proficiency in each of the tasks. Finally, self-ratings were collected from recent graduates of the program to indicate the effectiveness of the program. The goal of this analysis was to develop a training program

that would focus more time on tasks that were performed frequently, that were most important, and those that were more difficult to learn. All three conditions would not have to be met for a task to be included in the training program, but those tasks that were rated high in at least one category should receive more emphasis in the program than those that were not highly rated in any of the categories. This method incorporates both the matching technique and the linking technique and provides a quantitative measure of the training program. However, Bownas et al. caution that the interpretation of the correlation must be carefully made because they are not necessarily distributed as Pearson's r and statistical significance cannot be tested.

Training programs are constantly being designed, implemented, and evaluated in organizations. Often, the evaluation of the training program is overlooked or improperly performed by the organization. If the methods and techniques previously discussed are not applied, the organization runs the risk of having an ineffective program. It is necessary that the content of the program be related to the job, reflective of the importance of the job tasks, appropriate to the level of difficulty, and transferable to the job itself. If the matching, linking, or quantitative technique is applied to the program evaluation, then it is likely that a more effective program will be created. These methods do not have to exist in isolation; combining the techniques can offer more information that can further help the organization and its training program. The key is that the techniques are applied correctly and the most appropriate criteria are used for the program in question.

Current Study

In the current study, we examined the content validity of the WTI curriculum using, primarily, the matching technique discussed previously given the formative nature of the study. Later studies may use the linking technique to examine additional criteria as WTI develops more courses and produces more graduates. The WTI steering committee identified SMEs to evaluate the KSAs needed for job performance; the KSAs were rated on: time spent on the job, importance, and difficulty of learning. A job knowledge survey (JKS) assessing KSAs on these dimensions was developed and distributed to SMEs for completion. This survey served as the criterion for the content validation study and was graphed on the x-axis of the matching matrix.

In the second phase of the study, we had SMEs attend a course content workshop (CCW) where they identified the KSAs that are currently taught in the WTI courses and the amount of time spent teaching them. These data were graphed on the y-axis of the matching matrix. An analysis of the matching matrix identified areas that are hits and those that are misses for each of the four identified jobs. The proposed hypothesis for this study is:

Hypothesis 1: The content of the WTI courses will be directly related to the content of the proposed jobs for WTI students.

The current study is divided into two subsections: Criterion Development and Curriculum Matching. They each have unique participants, materials, and procedures.

Criterion Development

Method

Participants. A steering committee was previously assembled by the grant members as the most knowledgeable individuals about the Water and Wastewater Technician Industry for both Kentucky and Tennessee. The committee members represented various Water and Wastewater organizations from Kentucky and Tennessee including: Kentucky Rural Water Association, Kentucky Water and Wastewater Operators Association, American Water Works Association: Kentucky/Tennessee Section, Division of Compliance Assistance, Tennessee Association of Utility Districts, Glasgow Water Company, Bowling Green Community College, and Center for Water Resource Studies: WKU. The SMEs for the criterion development consisted of six steering committee members. The steering committee members collectively identified 40 other employees to serve as SMEs to respond to the Job Knowledge Survey (JKS) for the four entry-level jobs [Water Treatment Operator, Wastewater Treatment Operator, Distribution Systems Operator, and Collection Systems Operator]. The steering committee members included incumbents representing all four identified jobs.

Materials. A JKS was developed for each of the entry-level jobs: Water Treatment Operator, Wastewater Treatment Operator, Distribution Systems Operator, and Collection Systems Operator. The survey included a list of the KSAs derived from material provided by the Associate Director of the Center for Water Resource Studies at WKU. The materials

included a need-to-know criteria list for each of the entry level jobs, a job description for an Operator Trainee II, and the certification requirements for both Water Treatment and Collection Systems Operators. The need-to-know criteria list for a Water Treatment Operator may be found in Appendix A.

The JKS asked the SMEs to evaluate each KSA using a 5-point Likert scale for time spent on the job, importance to job, and difficulty of learning. Additionally, the SMEs were asked to indicate “yes” or “no” if the KSA should be taught in WTI, if the KSA was needed for certification, and where the KSA was currently learned (before hiring, job training, on the job). There was space for the SME to write in any additional KSAs that were needed for the job but were missing from the survey. The final version of the Job Knowledge Survey for the job of Water Treatment Operator may be found in Appendix B; analogous surveys were developed for the other three jobs. As can be seen in the sample JKS, items on the survey were organized by category, topic within category, and information within topic.

The research team developed the preliminary JKS based on materials received by the Associate Director of the Center for Water Resources Studies at WKU. The preliminary JKS listed all tasks and knowledge needed for successful performance in the four entry-level jobs: Water Treatment Operator, Wastewater Treatment Operator, Distribution Systems Operator, and Collection Systems Operator. A separate JKS was developed for each of the four jobs.

Based on Bownas, et al. (1985), the JKS included rating scales for time spent on job, importance to job, and difficulty of learning. Additional scales were included that

indicated where the KSA was learned, if it should be taught in WTI, and if it was needed for certification.

Procedure. The preliminary JKSs were distributed to the steering committee members during their WTI workshop conference in Louisville, KY. Demographic information also was collected including the SMEs job title, length of employment, state worked in, and certification level. The steering committee members pilot tested the surveys and provided feedback for refinement of the JKS. Although, the KSAs used for the JKS were drawn heavily from the Tennessee Water and Wastewater Industry, the WTI steering committee confirmed the KSAs were representative of the Kentucky Industry as well. The SMEs also agreed on the four jobs that were most likely to be entered into by a WTI graduate (a fifth job, Biological/Natural Systems Operator, was eliminated from the study). Finally, the committee members collectively identified and selected at least ten incumbents to serve as SMEs for each of the four jobs.

Committee recommendations were incorporated into the final JKS. The final surveys were mailed to the steering committee members for distribution to the job incumbent SMEs with a deadline of October 30, 2009 for return. Twenty-seven surveys were returned and were useable for data analysis.

Results

Statistical analyses were performed on responses to all four of the JKSs to calculate the means and standard deviations for each of the scales. These results may be found in Appendix C.

The data were examined using the matching technique described by Ford and Wroten (1984). Only KSAs that were rated as “should be taught in WTI” ($M \geq .5$) on the JKS were included in the analyses. Although the JKS were specified to the topic and information within topic level, the category level was used, when applicable, in the matrices. To determine if the category level could be used in the matrices, the KSAs included at the topic level had to meet multiple rational criteria that were set using professional judgment.

In order for topic level KSAs to be collapsed to the category level, they had to have an internal consistency reliability of alpha of .7 or higher. Those KSAs that did not meet this requirement were included in the matrices at the topic level. In addition to meeting the alpha requirement, each topic level KSA had to have an item total correlation of .5 or higher in order to be grouped into the category level. If the item total correlation was not met for a topic, the importance mean and difficulty of learning mean were examined to determine if the topic needed to be included at the topic level in the matrices (i.e., broken down within the category level). If the topic had an importance mean greater than 2.5 on a scale of 0 to 4 and a difficulty of learning mean greater than 3 on a scale of 1 to 5, then it was broken down within the category and used at the topic level in the matrices.

The reasoning behind these criteria was that any topics that were not moderately correlated with the other topics in a category and were very important should be graphed separately on the matrices. On the other hand, those topics that were highly correlated with other topics in the category level could be grouped together under a single category term that would then be graphed on the matrices.

Curriculum Matching

Method

Participants. The SMEs for the curriculum analysis were the two Bowling Green Community College instructors of the WTI courses. Due to the limited number of students enrolled in the courses (1), students were not included in this part of the study.

Materials. A course content form was developed for each available course based on the KSAs identified by the SMEs as being taught in the course. The forms measured how much time is spent teaching the KSA in the course. The course form for Course 210: Introduction to Water Treatment Processes may be found in Appendix D; analogous forms were created for the other courses.

Procedure. The WTI program currently has four courses in place that apply to the new Water and Wastewater Technician associate degree program: Water Supply and Wastewater Control, Water Distribution and Wastewater Collection System, Water and Wastewater Instrumentation and Control, and Water Treatment Process. Although more courses will be developed in the near future, only these four courses had been offered at the time of this study. Two instructors teach the courses using an online format; the classes have been under review as the instructors have been working with BGCC administration to develop a new curriculum that will meet the needs of the Kentucky and Tennessee Water and Wastewater Technician Industries.

During a Course Content Workshop (CCW), the instructors of the current WTI courses developed a list of the KSAs that are currently taught in each course. The lists were developed through a brainstorming panel discussion. The participants were asked to generate KSAs that are currently taught in the course and were supplied with their own online course outlines to further discussion. The SMEs were then shown a list of KSAs from the JKS that had been identified as Needing to be Taught in WTI and were asked to clarify terminology in order to link the terms used by the SMEs in the CCW to the terms used in the JKS. It was necessary to link the KSA terms in order to create the matching matrix comparing the importance of the KSA to the job and the time spent teaching the KSA in the course. Finally, the participants allocated 100 points among all the KSAs taught in each course to reflect emphasis given (i.e., time spent teaching a given KSA). Thus, a KSA that was heavily emphasized may have received a 20 while a low emphasis KSA may have received a 5. The total emphasis for all the KSAs from each course had to equal 100.

Results

A matching matrix was created for each of the four entry-level jobs identified by the SMEs. The matrices replicated the methods used by Ford and Wroten (1984) to identify KSAs that were hits, deficiencies (i.e., under emphasized), and excesses (i.e., over emphasized). The area on the matrices that represents each of these categories is illustrated in Figure 1. Any KSAs that are plotted within the grayed cells along the diagonal will be considered to be hits for that job.

Figure 1. Matching Matrix Template

		Matching Matrix			
Importance Rating	4				
	3				
	2				
	1				
		0-25	26-50	51-75	76+
		Course Emphasis			

Note: The table includes diagonal labels: 'Under Emphasized' (top-left to bottom-right), 'H I T' (center), and 'Over Emphasized' (bottom-left to top-right). Grayed cells are located at (4, 76+), (3, 51-75), (2, 26-50), and (1, 0-25).

The matrices reflect the emphasis placed on the KSAs across the entire curriculum; that is, the points allocated to a KSA will be added across all four courses to calculate one emphasis score. The breakdown of the time spent rating per course is included in a corresponding matrix key for each matrix. The mean ratings for importance, as determined from the JKS, were plotted on the y axis and the mean ratings for time spent, as determined from the CCW, were plotted on the x axis. Once the data were graphed onto the matrix, hits and misses could be identified. This allows for specific identification of which non-important KSAs are being over emphasized (i.e., excess), and which important KSAs are being under emphasized (i.e., deficiency). Additionally, KSAs that have matching levels of importance and emphasis are identified (i.e., hits).

The matching matrix for the job of Water Treatment Operator is displayed in Figure 2. There are no identified hits for this job; however, there are several KSAs that are near hits: Pumps, Electrical, Chemical Feeders, Units of Expression, Maps/Plans, Security-Attack, Lab Test, Cathodic Protection Devices, Valves, Pipes, Fittings, Joints, and Processes. The KSAs that were identified as being deficiencies were: Motors, Math, Safety Equipment, Sources and Characteristics, Pumps, Electrical, Chemical Feeders, Units of Expression, Maps/Plans, Security-Attack, Lab Test, Cathodic Protection Devices, Valves, Pipes, Fittings, and Joints. The KSAs that were identified as being excess were: Measuring and Control, and Processes.

The matching matrix for the job of Wastewater Treatment Operator is displayed in Figure 3. There are no identified hits for this job; however, there are several KSAs that are near hits: Sources and Characteristics, Hydraulics, Processes, Public Relations, and Maps/Plans. The KSAs that were identified as being deficiencies were: Electrical, Units

of Expression, Lab Test, WWT Processes, Advanced Treatment, Generators, Math, Sources and Characteristics, Hydraulics, Processes, Public Relations, and Maps/Plans.

The KSA that was identified as being excess was: Support Systems.

The matching matrix for the job of Distribution Systems Operator is displayed in Figure 4. There are no identified hits for this job; however, there are several KSAs that are near hits: Lab Tests, Units of Expression, Hydraulics, and Sources and Characteristics. The KSAs that were identified as being deficiencies were: Chemical Feeders, Maps/Plans, Processes, Math, Lab Tests, Units of Expression, Hydraulics, and Sources and Characteristics. The KSA that was identified as being excess was: Support Systems.

The matching matrix for the job of Collection Systems Operator is displayed in Figure 5. There are no identified hits for this job; however, there are several KSAs that are near hits: General Information and Processes. The KSAs that were identified as being deficiencies were: Cross Connections, Public Relations, Math, Transformers, General Information and Processes. The KSA that was identified as being excess was: Support Systems.

Figure 2. Water Treatment Operator Matrix

		Water Treatment Operator Matrix			
Importance Rating	4				
	3	Mo Ma SE SC			
	2	Pu LT EI CPD CF VA UE Pi MP Fi SA Jo		Pr	MC
	1				
		0-25	26-50	51-75	76+
		Course Emphasis			

KEY							
Abv.	Topic	Imp M	Course 200 Emphasis	Course 210 Emphasis	Course 212 Emphasis	Course 222 Emphasis	Sum Emphasis
EI	Electrical	2.33					0
MP	Maps/Plans	2.17	4	2			6
SC	Sources and Characteristics	2.5	12	8			20
UE	Units of Expression	2.25					0
LT	Lab Test	2.38	4				4
Pr	Processes	2.09	7.5	55			62.5
CPD	Cathodic Protection Devices	1.96		1			1
CF	Chemical Feeders	2.27	2.5	6			8.5
Fi	Fittings	1.67					0
Jo	Joints	1.67					0
MC	Measuring and Control	1.77	4			100	4
Mo	Motors	2.75	2.5				2.5
Pi	Pipes	1.78					0
Pu	Pumps	2.42	6.5				6.5
SE	Safety Equipment	2.52	4.5				4.5
SA	Security-Attack	2					0
Va	Valves	1.92	2.5				2.5
Ma	Math	2.58		16			16

Figure 3. Wastewater Treatment Operator Matrix

		Wastewater Treatment Operator Matrix			
Importance Rating	4				
	3	EI UE LT WWT AT Ge Ma			
	2	SC Hy Pr PR MP			SS
	1				
		0-25	26-50	51-75	76+
		Course Emphasis			

KEY							
Abv.	Topic	Imp M	Course 200 Emphasis	Course 210 Emphasis	Course 212 Emphasis	Course 222 Emphasis	Sum Emphasis
EI	Electrical	3					0
Hy	Hydraulics	2.14					0
MP	Maps/Plans	1.57	3				3
SC	Sources and Characteristics	2.35	2				2
UE	Units of Expression	3					0
WWT	WWT Processes	2.54	5.5				5.5
LT	Lab Tests	2.56					0
Pr	Processes	2.14	7.5				7.5
AT	Advanced Treatment	2.5	2.5				2.5
SS	Support Systems	1.78	2.5			100	102.5
Ge	Generators	2.5					0
PR	Public Relations	1.93					0
Ma	Math	2.5					0

Figure 4. Distribution Systems Operator Matrix

		Distribution Systems Operator Matrix			
Importance Rating	4				
	3	CF MP Pr Ma			
	2	LT UE Hy SC			SS
	1				
		0-25	26-50	51-75	76+
		Course Emphasis			

KEY							
Abv.	Topic	Imp M	Course 200 Emphasis	Course 210 Emphasis	Course 212 Emphasis	Course 222 Emphasis	Sum Emphasis
Hy	Hydraulics	2.13	2.5				2.5
MP	Maps/Plans	2.89	1				1
SC	Sources and Characteristics	2.13	12		2		14
UE	Units of Expression	2.28					0
LT	Lab Tests	2.4	4				4
Pr	Processes	2.68	9.5		10		19.5
SS	Support Systems	2.45	15.5		45	100	160.5
CF	Chemical Feeders	3.07	2.5				2.5
Ma	Math	2.63					0

Figure 5. Collection Systems Operator Matrix

		Collection Systems Operator Matrix			
Importance Rating	4				
	3	CC PR Ma Tr	Pr		
	2	GI			SS
	1				
		0-25	26-50	51-75	76+
		Course Emphasis			

KEY							
Abv.	Topic	Imp M	Course 200 Emphasis	Course 210 Emphasis	Course 212 Emphasis	Course 222 Emphasis	Sum Emphasis
GI	General Information	2.13	8		4.5		12.5
Pr	Processes	2.55	6		21		27
CC	Cross Connections	3.42					0
SS	Support Systems	2.21	2.5		11.5	100	114
Tr	Transformers	2.6					0
Ma	Math	2.6					0
PR	Public Relations	2.69					0

Discussion

The matching matrices for the four target jobs for WTI graduates to enter did not identify any hits for the KSAs being taught in the four current courses. However, the matrices did identify near hits, as well as deficiencies and excesses. As this study represents the first step in the formative evaluation of the WTI curriculum, these results will be helpful in redesigning the current courses offered and designing future courses. The instructors of the four courses reported on in this study may want to review the results of the matching matrices and redistribute the emphasis given to topics in those courses. It is likely that the addition of more courses that emphasize the KSAs that were deficiencies but near hits will move those KSAs into the target hit area on the matrices. Additionally, the KSA that was identified in all four job matrices as being excess, Support Systems, is the only KSA taught in Course 222; that is, the entire course focus is on Support Systems. This excess may indicate that the topic, Support Systems does not need to be taught in the other courses in the WTI curriculum to avoid this over emphasis. Finally, those KSAs that were identified as being under emphasized should be considered for inclusion when designing the content of future courses.

Limitations

There were several limitations present in this study. It would have been ideal to have more SMEs available to assist with the Curriculum Matching phase of the study. In Ford and Wroten (1984), SMEs developed a Course Content Survey during the CCW that was completed by students of the training program. However, there were no students available who had completed the current WTI curriculum. Thus, the emphasis ratings for the matching matrices came solely from the two SMEs in the CCW. Furthermore, the

method used in plotting the emphasis (using a total for the curriculum) was pragmatic, as it is allowed for better comprehension of the matrices; however, some precision was lost as a result.

Future Direction

This study has provided the WTI program with a foundation for assessing their current courses and suggestions for the content of future courses. The goal of WTI is to prepare students to be successful in the Water and Wastewater Technician jobs they will enter; thus, it is essential that the students be taught the KSAs that are important to jobs. Maintaining a curriculum that follows the hit trajectory of the matrices will assist WTI in meeting this goal. Additional content validity studies will need to be conducted as more courses are designed and incorporated into the WTI program. Finally, it is not intended for the provided matching matrices to be used in isolation when developing the courses for WTI. There are likely topics that are important for WTI student to learn, such as History of Wastewater, which may not have been identified as important for a specific job. However, the academic value of such topics should not be ignored. Future studies might measure these constructs and incorporate them into matching matrices.

After the WTI curriculum is established using additional content validation studies, it is suggested by Teachout, et al. (1997) that programs use different matching matrices to further their curriculum development. A possible manner in which WTI could accomplish this is by creating matrices that use training effectiveness or transfer as a criterion. Performance appraisals of WTI program graduates would serve as an effective method of measuring this criterion in future studies. Additionally, the mean ratings for

difficulty of learning, as measured by the JKS, would serve as an additional factor to compare to these new criteria, along with importance.

Conclusion

This study provided a content validity analysis of WTI's current curriculum in order to compare the on-the-job importance of KSAs being taught and the emphasis they are receiving in courses. The matching matrices created in the analysis did not indicate any hits, but there were several deficiencies that were near hits. The matrices are useful in identifying areas for which WTI instructors may want to increase or decrease emphasis as indicated. The study represents an early step in the process of designing the WTI curriculum with future content validity studies being needed as more courses are developed.

References

- Bownas, D., Bosshardt, M., & Donnelly, L. A. (1985). Quantitative Approach to Evaluating Training Curriculum Content Sampling Adequacy. *Personnel Psychology*, 38, 117-131.
- Ernest, A. (2009). Water and Wastewater Technician Training Institute. Grant awarded to Western Kentucky University Research Foundation. National Science Foundation (0903286). Available online at:
<http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0903286>
- Ford, J., & Wroten, S. (1984). Introducing New Methods for Conducting Training Evaluation and for Linking Training Evaluation to Program Redesign. *Personnel Psychology*, 37, 651-665.
- Sproule, C. (2010). *Rationale and Research Evidence Supporting the Use of Content Validation in Personnel Assessment*. Retrieved from International Personnel Assessment Council Website: <http://www.ipacweb.org>
- Teachout, M., Sego, D., & Ford, J. (1997). An Integrated Approach to Summative Evaluation for Facilitating Training Course Improvement. *Training Research Journal*, 3, 169-184.

Appendix A: Sample Need-to-Know Criteria List

Grade 1 Water Treatment Operator Need-To-Know Criteria (Subject Areas)

The following list of categories suggests topics of information that are important to know in order to be a successful and proficient Grade 4 Water Treatment Operator. The list may not be all-inclusive, and knowledge of additional topics may be of benefit to the operator.

Category of Information: Processes

- | | |
|--|---|
| <ul style="list-style-type: none"> Pre-Treatment <ul style="list-style-type: none"> ▪ Screens (Wells; Intake) Aeration <ul style="list-style-type: none"> ▪ Slat tray Disinfection <ul style="list-style-type: none"> ▪ Gas Chlorinators ▪ Hypochlorinators ▪ Chlorine Dioxide ▪ Mixed Oxidants ▪ Ultra-violet Fluoridation <ul style="list-style-type: none"> ▪ Fluorosilicic Acid ▪ Sodium fluoride ▪ Sodium Fluorosilicate Corrosion Control <ul style="list-style-type: none"> ▪ Corrosion Inhibitors ▪ Aeration | <ul style="list-style-type: none"> Iron/Manganese Removal <ul style="list-style-type: none"> ▪ Chemical Oxidation Precipitation <ul style="list-style-type: none"> ▫ Potassium Permanganate ▫ Sodium Permanganate ▫ Chlorine Dioxide ▪ Aeration ▪ Filters Storage <ul style="list-style-type: none"> ▪ Ground Storage ▪ Elevated Tanks ▪ Standpipes ▪ Hydropneumatic Tanks Cross Connections <ul style="list-style-type: none"> ▪ Air Gap ▪ Vacuum Breakers ▪ Backflow ▪ Backpressure ▪ Backsiphonage ▪ Cross Connection |
|--|---|

Category of Information: Support Systems

- | | |
|--|---|
| <ul style="list-style-type: none"> Motors <ul style="list-style-type: none"> ▪ Single Phase ▪ Three Phase Pumps <ul style="list-style-type: none"> ▪ Centrifugal ▪ Positive Displacement (Diaphragm) ▪ Turbine ▪ Metering Pipes <ul style="list-style-type: none"> ▪ Ductile Iron ▪ PVC ▪ Asbestos Cement Joints <ul style="list-style-type: none"> ▪ Flanged Valves <ul style="list-style-type: none"> ▪ Ball ▪ Check ▪ Globe ▪ Gate ▪ Pressure Control ▪ Vacuum Relief ▪ Butterfly ▪ Air Release ▪ Foot ▪ Altitude | <ul style="list-style-type: none"> Fittings <ul style="list-style-type: none"> ▪ Coupling ▪ Union ▪ Plug/Caps ▪ Corporation ▪ Curb Stop Cathodic Protection Devices <ul style="list-style-type: none"> ▪ Anode Rod/Bags ▪ Cathode Rod/Bags ▪ Rectifiers ▪ Dissimilar metals – Galvanic Corrosion Chemical Feeders <ul style="list-style-type: none"> ▪ Solids ▪ Liquids ▪ Evaporators ▪ Gas ▪ Slurry Safety <ul style="list-style-type: none"> ▪ Personal Protection Equipment ▪ Self Contained Breathing Apparatus ▪ Confined Space ▪ MSDS Information ▪ Traffic Control (Warning Devices; Barricades) ▪ Hazard Detection ▪ First Aid/Hygiene |
|--|---|

Category of Information: Support Systems (continued)

Measuring/Control

- Signal Generators
 - Magnetic Flowmeter
 - Parshall Flume
 - Rectangular Weir
 - Venturi
 - Propeller Meter
 - Ultrasonic
 - Pitot tube
- Signal Transmitters
 - Electric
 - Pneumatic
 - Hydraulic
- Meters
 - Electrical - Multi – VOM
 - Electrical - Multi – MA
- Alarms
- Controls
 - Pneumatic
 - Hydraulic
 - Timers

Security

- Attack
 - Prevention
 - Detection
 - Recovery

Category of Information: Lab Tests

Lab Tests

- | | |
|---|---|
| <ul style="list-style-type: none">▪ Alkalinity▪ Calcium▪ Disinfectant residual▪ Disinfectant demand▪ Fluoride▪ Orthophosphate▪ pH | <ul style="list-style-type: none">▪ Temperature▪ Total Coliform▪ Total Hardness▪ THM▪ HAA5▪ Turbidity▪ Specific Gravity |
|---|---|

Category of Information: General Information

Units of Expression

- Definition
- Conversion

Sources and Characteristics

- Characterization
- Quality/quantity
- Physical/chemical/biological characteristics

Electrical Concepts (Basic)

-

Maps/Plans

Appendix B: Sample Job Knowledge Survey

Water Treatment Operator – ENTRY LEVEL/Class 1/Grade 1

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
General Information	Electrical	Basic Concepts	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Maps/Plans		BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Sources and Characteristics	Biological/ Chemical/ Physical	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Characterization	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Quality/Quantity	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Units of Expression	Conversion	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Definition	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Lab Tests	Lab Tests	Alkalinity	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Calcium	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Disinfectant Demand	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Disinfectant Residual	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Fluoride	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		HAA5	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Lab Tests	Lab Tests	Orthophosphate	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		pH	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Specific Gavity	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Temperature	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		THM	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Total Coliform	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Total Hardness	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Turbidity	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Processes	Aeration	Slat Tray	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Corrosion Control	Aeration	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Corrosion Inhibitors	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Cross Connections	Air Gap	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Backflow	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Backpressure	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Backsiphonage	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Processes	Cross Connections	Cross Connection	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Vacuum Breakers	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Disinfection	Chlorine Dioxide	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Gas Chlorinators	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Hypochlorinators	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Mixed Oxidants	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Ultra-violet	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Fluoridation	Fluorosilicic Acid	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Sodium Fluoride	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Sodium Fluorosilicate	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Iron/Manganese Removal	Aeration	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Chemical Oxidation Precipitation – Chlorine Dioxide	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Chemical Oxidation Precipitation – Sodium Permanganate	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Chemical Oxidation Precipitation – Potassium Permanganate	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Filters	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Processes	Pre-Treatment	Screens	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Storage	Elevated Tanks	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Ground Storage	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Hydropneumatic Tanks	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Standpipes	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Support Systems	Cathodic Protection Devices	Anode Rod/Bags	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Cathode Rod/Bags	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Dissimilar Metals	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Rectifiers	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Chemical Feeders	Evaporators	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Gas	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Liquids	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Slurry	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Solids	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Fittings	Corporation	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
Support Systems	Fittings	Coupling	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Curb Stop	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Plug/Caps	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Union	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Joints	Flanged	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Measuring and Control	Alarms	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Controls-Pneumatic	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Controls-Hydraulic	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Controls-Timers	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Meters – Electrical (Multi-MA)	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Meters – Electrical (Mutli-VOM)	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Generators-Magnetic Flowmeter	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Generators-Venturi	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Signal Generators-Parshall Flume	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Generators-Pilot Tube	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Generators-Propeller Meter	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Support Systems	Measuring and Control	Signal Generators-Rectangular Weir	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Generators-Ultrasonic	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Transmitters-Electric	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Transmitters-Hydraulic	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Signal Transmitters-Pneumatic	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Motors	Single Phase	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Three Phase	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Pipes	Abestos Cement	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Ductile Iron	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		PVC	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Pumps	Centrifugal	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Metering	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Positive Displacement - Diaphragm	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Turbine	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Safety Equipment	Confined Space	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		First Aid/Hygiene	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Support Systems	Safety Equipment	Hazard Detection	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		MSDS Information	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Personal Protection Equipment	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Self Contained Breathing Apparatus	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Traffic Control	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Security	Attack-Detection	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Attack-Prevention	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Attack-Recovery	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Valves	Air Release	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Altitude	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Ball	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Butterfly	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Check	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Foot	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Gate	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Globe	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Support Systems	Valves	Pressure Control	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Vacuum Relief	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Other	Public Relations	Answer Phones	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Customer Questions	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Work Orders	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Emergency Requests	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Plant Tours	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
	Math	Basic Calculations	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
		Advanced Calculations	BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
Below please add any topic or information that is part of the job but has been omitted from this questionnaire. Please rate the topics/information you add.								
			BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
			BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
			BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y
			BH JT OTJ	1 2 3 4 5	0 1 2 3 4	0 1 2 3 4	N Y	N Y

Appendix C: Job Knowledge Survey Ratings Means

Water Treatment Operator – ENTRY LEVEL/Class 1/Grade 1

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
General Information	Electrical	Basic Concepts	1.50 (.84)	3.67 (.52)	1.67 (.82)	2.33 (.82)	.83 (.41)	.33 (.52)
	Maps/Plans		1.67 (.82)	2.50 (.55)	1.67 (.52)	2.17 (1.33)	.83 (.41)	.50 (.55)
	Sources and Characteristics	Biological/ Chemical/ Physical	1.33 (.52)	3.50 (.55)	2.33 (.52)	2.50 (1.05)	.83 (.41)	1.00 (.00)
		Characterization	1.67 (.82)	3.50 (.55)	2.17 (.41)	2.33 (.82)	.83 (.41)	1.00 (.00)
		Quality/Quantity	1.67 (.82)	3.00 (.89)	2.50 (.55)	2.67 (.82)	.83 (.41)	1.00 (.00)
	Units of Expression	Conversion	1.00 (.00)	3.00 (.89)	2.00 (.63)	2.50 (.84)	.83 (.41)	1.00 (.00)
		Definition	1.00 (.00)	2.67 (.82)	1.83 (.41)	2.00 (.63)	.83 (.41)	1.00 (.00)
Lab Tests	Lab Tests	Alkalinity	1.17 (.41)	2.50 (.55)	2.00 (.00)	2.17 (.98)	1.00 (.00)	.83 (.41)
		Calcium	1.17 (.41)	2.50 (.55)	2.00 (.00)	2.00 (.89)	1.00 (.00)	.83 (.41)
		Disinfectant Demand	1.33 (.52)	2.33 (.52)	2.33 (.52)	2.83 (.41)	1.00 (.00)	1.00 (.00)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Disinfectant Residual	1.33 (.52)	2.33 (.52)	2.50 (.55)	3.17 (.41)	1.00 (.00)	1.00 (.00)
		Fluoride	1.33 (.52)	2.33 (.52)	2.00 (.00)	2.67 (.52)	1.00 (.00)	1.00 (.00)
		HAA5	1.50 (.84)	4.00 (.90)	1.50 (1.05)	2.33 (.82)	.83 (.41)	.83 (.41)
Lab Tests	Lab Tests	Orthophosphate	1.50 (.55)	3.00 (.89)	1.67 (.52)	1.67 (.82)	.83 (.41)	.83 (.41)
		pH	1.17 (.41)	1.83 (.98)	2.50 (.55)	3.17 (.75)	1.00 (.00)	1.00 (.00)
		Specific Gavity	1.50 (.55)	1.83 (.75)	1.50 (.55)	1.67 (1.03)	1.00 (.00)	1.00 (.00)
		Temperature	1.17 (.41)	1.50 (.84)	1.50 (.55)	1.67 (1.03)	1.00 (.00)	1.00 (.00)
		THM	1.83 (.75)	4.00 (.89)	1.50 (1.05)	2.17 (.75)	.83 (.41)	.83 (.41)
		Total Coliform	1.33 (.52)	3.33 (.82)	1.67 (.82)	2.83 (1.17)	1.00 (.00)	1.00 (.00)
		Total Hardness	1.33 (.52)	2.17 (.75)	1.67 (.52)	1.83 (.75)	1.00 (.00)	1.00 (.00)
		Turbidity	1.17 (.41)	1.67 (.82)	2.50 (1.05)	3.17 (.75)	1.00 (.00)	1.00 (.00)
Processes	Aeration	Slat Tray	2.00 (.63)	2.33 (.82)	1.33 (.52)	1.50 (.84)	.67 (.52)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Corrosion Control	Aeration	1.80 (.84)	2.60 (.55)	1.60 (.55)	1.80 (.84)	.80 (.45)	1.00 (.00)
		Corrosion Inhibitors	1.50 (.55)	2.83 (.75)	1.83 (.41)	2.00 (.63)	1.00 (.00)	1.00 (.00)
	Cross Connections	Air Gap	1.20 (.45)	2.17 (.75)	1.50 (.55)	2.33 (.52)	1.00 (.00)	1.00 (.00)
		Backflow	1.50 (.84)	2.67 (1.03)	1.50 (.55)	2.33 (.52)	1.00 (.00)	1.00 (.00)
		Backpressure	1.50 (.84)	2.83 (1.17)	1.50 (.55)	2.17 (.41)	1.00 (.00)	1.00 (.00)
		Backsiphonage	1.50 (.84)	2.83 (1.17)	1.50 (.55)	2.33 (.52)	1.00 (.00)	1.00 (.00)
Processes	Cross Connections	Cross Connection	1.00 (.00)	2.83 (.75)	1.50 (.55)	2.17 (.75)	1.00 (.00)	1.00 (.00)
		Vacuum Breakers	1.33 (.82)	2.50 (1.05)	1.17 (.41)	2.17 (.75)	1.00 (.00)	.83 (.41)
	Disinfection	Chlorine Dioxide	1.67 (1.03)	3.50 (.84)	1.67 (1.03)	2.83 (1.17)	1.00 (.00)	.83 (.41)
		Gas Chlorinators	1.00 (.00)	3.17 (.75)	2.33 (.52)	3.17 (.75)	1.00 (.00)	1.00 (.00)
		Hypochlorinators	1.00 (.00)	2.83 (.41)	2.00 (.63)	3.00 (.63)	1.00 (.00)	1.00 (.00)
		Mixed Oxidants	1.67 (1.03)	3.00 (.63)	1.50 (.84)	2.67 (.52)	1.00 (.00)	.83 (.41)
		Ultra-violet	1.67 (1.03)	2.83 (1.17)	1.67 (1.03)	1.67 (1.03)	1.00 (.00)	.67 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Fluoridation	Fluorosilicic Acid	1.50 (.84)	2.50 (.84)	1.33 (.82)	2.33 (1.21)	1.00 (.00)	1.00 (.00)
		Sodium Fluoride	1.17 (.41)	2.50 (.84)	1.67 (.52)	2.17 (.98)	1.00 (.00)	1.00 (.00)
		Sodium Fluorosilicate	1.17 (.41)	2.50 (.84)	1.67 (.52)	2.17 (.98)	1.00 (.00)	1.00 (.00)
	Iron/Manganese Removal	Aeration	1.33 (.82)	2.50 (.55)	1.50 (.55)	1.67 (.82)	.80 (.45)	1.00 (.00)
		Chemical Oxidation Precipitation – Chlorine Dioxide	1.83 (.98)	3.17 (.41)	1.67 (1.03)	2.50 (1.05)	1.00 (.00)	1.00 (.00)
		Chemical Oxidation Precipitation – Sodium Permanganate	1.00 (.00)	3.00 (.63)	2.00 (.82)	2.33 (.82)	1.00 (.00)	1.00 (.00)
		Chemical Oxidation Precipitation – Potassium Permanganate	1.17 (.41)	3.00 (.63)	2.00 (.63)	2.33 (.82)	1.00 (.00)	1.00 (.00)
		Filters	1.00 (.00)	2.67 (.52)	2.17 (.75)	3.00 (.63)	1.00 (.00)	1.00 (.00)
Processes	Pre-Treatment	Screens	1.50 (.84)	1.67 (.82)	1.00 (.63)	1.33 (1.21)	.83 (.41)	.67 (.52)
	Storage	Elevated Tanks	1.17 (.41)	2.33 (.52)	1.83 (.75)	2.50 (.55)	1.00 (.00)	1.00 (.00)
		Ground Storage	1.17 (.41)	2.33 (.52)	1.83 (.75)	2.50 (.55)	1.00 (.00)	1.00 (.00)
		Hydropneumatic Tanks	1.67 (.82)	2.67 (.82)	1.50 (.55)	2.50 (.55)	.83 (.41)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Standpipes	1.33 (.52)	2.33 (.52)	1.83 (.75)	2.50 (.55)	1.00 (.00)	1.00 (.00)
Support Systems	Cathodic Protection Devices	Anode Rod/Bags	2.17 (.98)	3.00 (.63)	1.33 (.52)	2.17 (.75)	.60 (.55)	.67 (.52)
		Cathode Rod/Bags	2.17 (.98)	3.00 (.63)	1.33 (.52)	2.00 (.63)	.60 (.55)	.67 (.52)
		Dissimilar Metals	1.83 (.98)	3.00 (.63)	1.33 (.52)	1.83 (.75)	.80 (.45)	.83 (.41)
		Rectifiers	1.83 (.98)	3.33 (.82)	1.50 (.84)	1.83 (.75)	.80 (.45)	.33 (.52)
	Chemical Feeders	Evaporators	1.67 (.82)	2.83 (.41)	1.50 (.55)	2.33 (.82)	1.00 (.00)	.83 (.41)
		Gas	1.17 (.41)	3.00 (.63)	2.17 (.41)	2.67 (1.03)	1.00 (.00)	1.00 (.00)
		Liquids	1.17 (.41)	2.67 (.52)	2.17 (.41)	2.33 (.52)	1.00 (.00)	1.00 (.00)
		Slurry	1.17 (.41)	2.83 (.75)	1.40 (.55)	2.00 (.00)	1.00 (.00)	1.00 (.00)
		Solids	1.17 (.41)	2.50 (.55)	2.00 (.71)	2.00 (.00)	1.00 (.00)	1.00 (.00)
	Fittings	Corporation	1.17 (.41)	2.00 (.89)	1.60 (.55)	1.67 (.52)	1.00 (.00)	.83 (.41)
Support Systems	Fittings	Coupling	1.17 (.41)	1.83 (.75)	1.50 (.55)	1.67 (.52)	1.00 (.00)	.83 (.41)

		Curb Stop	1.17 (.41)	2.00 (.89)	1.33 (.52)	1.67 (.52)	1.00 (.00)	.83 (.41)
		Plug/Caps	1.17 (.41)	1.83 (.75)	1.33 (.52)	1.67 (.52)	1.00 (.00)	.83 (.41)
		Union	1.17 (.41)	2.00 (.89)	1.50 (.55)	1.67 (.52)	1.00 (.00)	.83 (.41)
	Joints	Flanged	1.17 (.41)	1.83 (.75)	1.50 (.55)	1.67 (.52)	1.00 (.00)	.83 (.41)
	Measuring and Control	Alarms	2.00 (.89)	2.67 (1.03)	1.67 (.82)	2.17 (.75)	.83 (.41)	.33 (.52)
		Controls-Pneumatic	1.67 (.82)	3.00 (1.10)	1.83 (.75)	1.83 (.75)	.83 (.41)	.50 (.55)
		Controls-Hydraulic	1.50 (.84)	3.00 (1.10)	2.00 (.63)	2.17 (.41)	.83 (.41)	.67 (.52)
		Controls-Timers	1.50 (.84)	2.67 (1.03)	2.00 (.89)	2.00 (.63)	.83 (.41)	.50 (.55)
		Meters – Electrical (Multi-MA)	1.67 (.82)	3.40 (1.34)	1.80 (1.10)	1.80 (.84)	.80 (.45)	.20 (.45)
		Meters – Electrical (Mutli-VOM)	1.67 (.82)	3.40 (1.34)	1.80 (1.10)	1.80 (.84)	.80 (.45)	.20 (.45)
		Signal Generators- Magnetic Flowmeter	1.50 (.84)	3.00 (1.26)	1.67 (1.03)	1.67 (.82)	.83 (.41)	.60 (.55)
		Signal Generators- Venturi	1.33 (1.03)	2.67 (1.37)	2.00 (1.26)	1.83 (.98)	1.00 (.63)	.67 (.52)
		Signal Generators- Parshall Flume	1.33 (1.03)	2.50 (1.38)	1.67 (1.51)	1.67 (1.03)	1.00 (.71)	.33 (.52)
		Signal Generators- Pilot Tube	1.50 (1.29)	2.60 (1.52)	2.00 (1.41)	1.80 (1.10)	1.00 (.71)	.60 (.55)
		Signal Generators- Propeller Meter	1.33 (1.03)	2.50 (1.38)	2.17 (1.17)	1.83 (.98)	1.00 (.63)	.50 (.55)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
Support Systems	Measuring and Control	Signal Generators-Rectangular Weir	1.40 (1.14)	2.17 (1.17)	1.67 (1.21)	1.50 (.84)	.83 (.41)	.50 (.55)
		Signal Generators-Ultrasonic	1.40 (1.14)	2.17 (1.17)	1.83 (1.17)	1.67 (.82)	.83 (.41)	.50 (.55)
		Signal Transmitters-Electric	1.50 (1.29)	2.40 (1.34)	2.00 (1.22)	1.60 (.89)	.80 (.45)	.20 (.45)
		Signal Transmitters-Hydraulic	1.50 (1.29)	2.40 (1.34)	1.80 (1.30)	1.60 (.89)	.80 (.45)	.40 (.55)
		Signal Transmitters-Pneumatic	1.50 (1.29)	2.40 (1.34)	1.80 (1.30)	1.60 (.89)	.80 (.45)	.20 (.45)
	Motors	Single Phase	1.00 (.71)	2.83 (1.47)	2.00 (.89)	2.67 (1.03)	1.00 (.00)	1.00 (.00)
		Three Phase	1.00 (.71)	2.83 (1.47)	2.00 (.89)	2.83 (1.17)	1.00 (.00)	1.00 (.00)
	Pipes	Abestos Cement	1.17 (.75)	1.83 (.75)	1.33 (.52)	1.83 (1.33)	.83 (.41)	.83 (.41)
		Ductile Iron	1.20 (.45)	2.17 (1.17)	1.50 (.55)	1.83 (.98)	.80 (.45)	1.00 (.00)
		PVC	1.20 (.45)	1.83 (.75)	1.50 (.55)	1.67 (.82)	.80 (.45)	1.00 (.00)
	Pumps	Centrifugal	1.20 (.45)	2.67 (1.03)	2.00 (.63)	2.50 (.55)	1.00 (.00)	1.00 (.00)
		Metering	1.20 (.45)	2.50 (1.22)	2.17 (.98)	2.50 (.55)	1.00 (.00)	1.00 (.00)
		Positive Displacement - Diaphragm	1.20 (.45)	2.80 (1.10)	2.17 (.75)	2.50 (.55)	1.00 (.00)	1.00 (.00)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Turbine	1.20 (.45)	3.20 (.45)	2.00 (.63)	2.17 (.98)	1.00 (.00)	1.00 (.00)
	Safety Equipment	Confined Space	1.60 (.55)	2.83 (1.17)	1.33 (1.03)	2.40 (1.52)	.67 (.52)	.50 (.55)
		First Aid/Hygiene	1.40 (.55)	2.33 (.82)	1.17 (.75)	1.40 (1.52)	.50 (.55)	.00 (.00)
Support Systems	Safety Equipment	Hazard Detection	1.50 (.55)	2.83 (1.17)	1.67 (.82)	2.67 (.52)	.83 (.41)	.50 (.55)
		MSDS Information	1.67 (.52)	2.17 (.75)	1.33 (.52)	2.67 (.52)	.83 (.41)	.67 (.52)
		Personal Protection Equipment	1.33 (.52)	2.17 (.75)	1.83 (.75)	2.83 (.41)	.83 (.41)	.83 (.41)
		Self Contained Breathing Apparatus	1.50 (.55)	2.83 (1.17)	1.50 (.84)	2.67 (.52)	.50 (.55)	.67 (.52)
		Traffic Control	1.83 (.75)	2.17 (.98)	1.50 (.84)	2.67 (.52)	.50 (.55)	.50 (.55)
	Security	Attack-Detection	1.83 (.75)	2.67 (.82)	1.33 (.52)	2.00 (1.10)	.50 (.55)	.00 (.00)
		Attack-Prevention	1.83 (.75)	2.83 (.98)	1.33 (.52)	2.00 (1.10)	.50 (.55)	.00 (.00)
		Attack-Recovery	1.83 (.75)	2.83 (.98)	1.33 (.52)	2.00 (1.10)	.50 (.55)	.00 (.00)
	Valves	Air Release	1.17 (.41)	2.00 (.00)	1.17 (.41)	2.00 (.89)	1.00 (.00)	.83 (.41)
		Altitude	1.17 (.41)	2.50 (.55)	1.33 (.52)	1.83 (.75)	1.00 (.00)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Ball	1.17 (.41)	1.83 (.41)	1.33 (.52)	1.67 (.52)	1.00 (.00)	.83 (.41)
		Butterfly	1.17 (.41)	1.83 (.41)	1.67 (.82)	2.00 (.63)	1.00 (.00)	.83 (.41)
		Check	1.17 (.41)	2.20 (.84)	1.67 (.82)	2.00 (.63)	1.00 (.00)	.83 (.41)
		Foot	1.17 (.41)	2.00 (.63)	1.33 (.82)	1.67 (.52)	1.00 (.00)	.83 (.41)
		Gate	1.17 (.41)	1.83 (.41)	1.67 (.82)	2.00 (.63)	1.00 (.00)	.83 (.41)
		Globe	1.17 (.41)	2.00 (.00)	1.50 (.84)	1.83 (.41)	1.00 (.00)	.83 (.41)
Support Systems	Valves	Pressure Control	1.17 (.41)	2.60 (.89)	1.60 (.89)	2.20 (.84)	1.00 (.00)	.80 (.45)
		Vacuum Relief	1.17 (.41)	2.40 (.55)	1.20 (.45)	2.00 (1.00)	1.00 (.00)	.80 (.45)
Other	Public Relations	Answer Phones	2.25 (.96)	1.60 (.55)	1.00 (.71)	.60 (.89)	.00 (.00)	.00 (.00)
		Customer Questions	2.60 (.55)	2.67 (.82)	1.00 (.63)	1.17 (1.17)	.17 (.41)	.00 (.00)
		Work Orders	2.25 (.96)	1.80 (.84)	1.20 (.84)	1.00 (1.00)	.20 (.45)	.00 (.00)
		Emergency Requests	2.75 (.50)	2.60 (.89)	1.00 (.71)	2.00 (1.22)	.00 (.00)	.00 (.00)
		Plant Tours	2.75 (.50)	2.40 (.55)	1.00 (.71)	.40 (.89)	.00 (.00)	.00 (.00)

	Math	Basic Calculations	1.00 (.00)	2.67 (.52)	2.00 (.63)	2.50 (.55)	.83 (.41)	1.00 (.00)
		Advanced Calculations	1.00 (.00)	3.60 (.55)	1.80 (.84)	2.80 (.45)	.80 (.45)	1.00 (.00)

Wastewater Treatment Operator – Means

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
General Information	Electrical	Basic Concepts	1.71 (.75)	3.43 (.53)	1.57 (.53)	3.00 (1.26)	2.00 (.00)	.67 (.52)
	Hydraulics	Basic Concepts	2.14 (.69)	3.43 (.53)	1.71 (.76)	2.14 (.69)	2.00 (.00)	.50 (.55)
	Maps/Plans	Interpretation and Use	2.57 (.53)	2.86 (.69)	1.28 (.49)	1.57 (.79)	1.86 (.38)	.50 (.55)
	Sources and Characteristics	Characterize	2.14 (.69)	3.43 (.79)	2.14 (1.07)	2.50 (.84)	2.00 (.00)	.83 (.41)
		Chemical Pre-Treatment	2.14 (.38)	3.28 (.95)	1.86 (1.07)	2.33 (1.03)	1.83 (.41)	.83 (.41)
		Effects	2.50 (.55)	3.17 (.41)	1.80 (.84)	2.00 (.82)	2.00 (.00)	.80 (.45)
		Grease Control	2.57 (.53)	2.86 (.69)	1.86 (.69)	2.33 (1.03)	2.00 (.00)	.33 (.52)
		Physical/Chemical/ Biological Characteristics	2.17 (.41)	3.43 (.53)	2.00 (.58)	2.83 (.75)	2.00 (.00)	1.00 (.00)
		Pre-aeration	2.43 (.53)	2.86 (.69)	1.71 (.76)	2.00 (1.10)	1.67 (.52)	.50 (.55)
		Quality/Quantity	2.29 (.76)	3.43 (.98)	2.00 (.82)	2.33 (.52)	1.83 (.41)	.67 (.52)
	Units of Expression	Conversion	2.17 (.41)	3.43 (.79)	2.14 (3.78)	3.00 (.89)	2.00 (.00)	1.00 (.00)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Definition	2.17 (.41)	3.29 (.49)	2.00 (.58)	3.00 (.63)	2.00 (.00)	1.00 (.00)
	WWT Processes	Describe Processes	2.00 (.58)	3.57 (.53)	2.57 (.79)	3.00 (1.09)	2.00 (.00)	1.00 (.00)
		Explain Why Treated	2.29 (.48)	3.28 (.76)	2.28 (.76)	2.50 (1.22)	2.00 (.00)	.67 (.52)
		Goals of WWT	2.00 (.82)	3.00 (.82)	2.00 (.82)	2.57 (.79)	2.00 (.00)	.83 (.41)
General Information	WWT Processes	Sketch Sequence	2.00 (.58)	2.71 (.76)	1.71 (.49)	2.29 (.76)	2.00 (.00)	.83 (.41)
Lab Tests	Control Tests	Alkalinity	2.00 (.82)	3.14 (1.21)	1.57 (.79)	2.14 (1.21)	1.86 (.38)	.83 (.41)
		Centrifuge	2.14 (.69)	2.71 (1.25)	2.00 (.82)	2.71 (.95)	2.00 (.00)	.50 (.55)
		C.O.D.	1.86 (.69)	3.29 (1.11)	1.57 (.79)	2.43 (.98)	1.86 (.38)	.83 (.41)
		Micro Exam	1.86 (.69)	3.86 (1.21)	1.57 (.79)	2.29 (1.11)	2.00 (.00)	.83 (.41)
		Nitrate- Nitrite	2.00 (.82)	3.71 (.76)	1.57 (.79)	2.43 (1.13)	1.86 (.38)	.83 (.41)
		Nutrients	2.00 (.63)	3.71 (.76)	1.71 (.76)	2.71 (.76)	1.86 (.38)	.83 (.41)
		Oil and Grease	2.17 (.75)	3.57 (.79)	1.71 (.76)	2.43 (1.13)	1.86 (.38)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Routine Tests	Ammonia	1.86 (.69)	3.71 (.76)	1.86 (.69)	2.86 (.69)	1.86 (.38)	.83 (.41)
		B.O.D.	1.86 (.69)	4.14 (.89)	2.00 (.82)	2.86 (.69)	1.86 (.38)	.83 (.41)
		Chlorine Residual	1.86 (.69)	2.86 (1.07)	1.86 (.69)	2.86 (.69)	2.00 (.00)	.83 (.41)
		Coliform (Fecal)	1.86 (.69)	3.43 (.98)	1.71 (.76)	2.86 (.69)	1.86 (.38)	.83 (.41)
		Dissolved Oxygen	2.00 (.63)	2.71 (1.11)	1.86 (.69)	2.86 (.69)	2.00 (.00)	.83 (.41)
		E. Coli	2.00 (.58)	3.43 (.98)	1.71 (.76)	2.86 (.69)	1.86 (.38)	.83 (.41)
		pH	1.86 (.69)	2.86 (1.07)	1.86 (.69)	2.71 (.76)	1.86 (.38)	.83 (.41)
		Total Kjedadhl Nitrogen	2.14 (.69)	3.57 (.79)	1.43 (.97)	2.14 (1.34)	1.57 (.53)	.67 (.52)
Lab Tests	Special Tests	Biomonitoring	2.43 (.53)	4.00 (1.00)	1.43 (1.13)	2.29 (1.25)	1.57 (.53)	.50 (.55)
		Cyanide	2.28 (.49)	3.86 (.89)	1.14 (1.21)	1.86 (1.34)	1.57 (.53)	.50 (.55)
		Metals	2.14 (.69)	3.86 (.89)	1.14 (1.21)	2.00 (1.29)	1.71 (.49)	.50 (.55)
		Phosphorus	2.00 (.58)	3.43 (.79)	1.57 (.97)	2.14 (1.21)	1.71 (.49)	.83 (.41)
		Setteability	2.00 (.58)	2.43 (1.40)	1.86 (.90)	2.28 (.95)	1.71 (.49)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Solids – Settleable	2.00 (.58)	2.71 (1.25)	1.86 (.90)	2.43 (.79)	1.86 (.38)	.83 (.41)
		Solids – Suspended	2.14 (.69)	3.00 (1.00)	1.86 (.90)	2.43 (.98)	1.86 (.38)	.83 (.41)
		Solids – Total	2.14 (.69)	2.86 (1.07)	1.71 (.76)	2.14 (1.07)	1.86 (.38)	.67 (.52)
		Solids – Total Dissolved	2.14 (.69)	2.71 (.76)	1.57 (.98)	1.86 (1.21)	1.71 (.49)	.50 (.55)
		Solids – Volatile	2.14 (.69)	3.00 (1.00)	1.57 (.98)	2.14 (1.21)	1.71 (.49)	.83 (.41)
		Temperature	2.00 (.82)	2.28 (1.49)	1.43 (.98)	2.14 (1.34)	1.86 (.38)	.67 (.52)
		Total Organic Carbon	2.43 (.53)	3.57 (.79)	1.28 (1.11)	1.86 (1.07)	1.57 (.53)	.50 (.55)
		Turbidity	2.28 (.49)	3.00 (1.15)	1.14 (1.21)	1.57 (1.27)	1.57 (.53)	.50 (.55)
		Volatile Acids	2.28 (.76)	3.71 (.76)	1.14 (1.21)	1.86 (1.34)	1.71 (.49)	.67 (.52)
Processes	Activated Sludge	Contact Stabilization	2.57 (.53)	3.00 (.00)	1.86 (.69)	2.17 (.75)	2.00 (.00)	.50 (.55)
		Conventional	2.29 (.76)	3.14 (.38)	2.14 (.69)	2.50 (.55)	2.00 (.00)	.67 (.52)
Processes	Activated Sludge	Extended Aeration	2.29 (.76)	3.28 (.49)	2.14 (.69)	2.50 (.55)	2.00 (.00)	.67 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Membrane Biological Reactor (MBR)	2.43 (.79)	3.29 (.49)	2.14 (.69)	2.33 (.52)	1.86 (.38)	.50 (.55)
		Oxidation Ditch	2.29 (.76)	3.00 (.58)	2.00 (.58)	2.33 (.52)	2.00 (.00)	.67 (.52)
		Sequencing Batch Reactor (SBR)	2.43 (.79)	3.29 (.49)	2.29 (.76)	2.50 (.55)	1.86 (.38)	.50 (.55)
		Step Feed	2.71 (.49)	3.43 (.53)	2.29 (.76)	2.50 (.55)	1.86 (.38)	.33 (.52)
		Tapered Aeration	2.71 (.49)	3.43 (.53)	2.29 (.76)	2.50 (.55)	1.71 (.49)	.33 (.52)
		Types of Aeration	2.57 (.53)	3.29 (.49)	2.14 (.69)	2.50 (.55)	1.71 (.49)	.33 (.52)
	Advanced Treatment	Biological	2.29 (.76)	3.14 (.38)	2.00 (.58)	2.50 (.55)	1.86 (.38)	.50 (.55)
		Nitrogen Removal	2.43 (.79)	3.43 (.53)	2.14 (.69)	2.50 (.55)	1.86 (.38)	.50 (.55)
	Attached Growth/ Fixed Film	Activated Biofilter (ABF)	2.43 (.79)	3.29 (.49)	2.00 (.58)	2.00 (.82)	1.86 (.38)	.50 (.55)
		Rotating Biology Contactor (RBC)	2.57 (.53)	3.29 (.49)	1.71 (.49)	1.71 (.76)	1.71 (.49)	.33 (.52)
		Trickling Filters	2.43 (.79)	2.86 (.90)	1.71 (.49)	1.71 (.76)	1.86 (.38)	.33 (.52)
	Clarification	Primary	2.29 (.76)	2.57 (.53)	1.71 (.49)	2.14 (.69)	2.00 (.00)	.67 (.52)

		Secondary	2.29 (.76)	2.71 (.49)	1.71 (.49)	2.14 (.38)	2.00 (.00)	.67 (.52)
	Collection Systems	Inflow, Infiltration, Exfiltration	2.57 (.53)	2.71 (.49)	1.71 (.49)	2.29 (.49)	1.86 (.38)	.33 (.52)
		Pre-treatment	2.29 (.76)	3.29 (.49)	2.14 (.69)	2.43 (.53)	2.00 (.00)	.50 (.55)
		Pump Stations	2.29 (.76)	3.00 (.00)	2.14 (.69)	2.57 (.53)	2.00 (.00)	.33 (.52)
Processes	Collection Systems	Sources of Wastewater	2.57 (.53)	2.57 (.53)	1.86 (.38)	2.43 (.53)	2.00 (.00)	.33 (.52)
		Types	2.43 (.53)	2.71 (.49)	2.00 (.58)	2.14 (.69)	1.86 (.38)	.33 (.52)
	Cross-Connection	Prevention	2.29 (.76)	2.86 (.38)	1.57 (.53)	2.14 (.69)	2.00 (.00)	.50 (.55)
		Types of Devices	2.43 (.53)	3.14 (.38)	1.57 (.53)	2.14 (.69)	1.86 (.38)	.33 (.52)
	Disinfection/ Use of Chlorine	Chlorination	2.29 (.76)	3.29 (.49)	2.00 (.00)	2.57 (.53)	2.00 (.00)	.67 (.52)
		Dechlorination	2.29 (.75)	3.29 (.49)	2.00 (.00)	2.57 (.53)	2.00 (.00)	.67 (.52)
		Other Methods	2.57 (.53)	3.00 (.58)	2.00 (.00)	2.14 (.69)	1.86 (.38)	.33 (.52)
		UV	2.43 (.79)	2.86 (.38)	2.00 (.00)	2.29 (.49)	2.00 (.00)	.33 (.52)
	Effluent Disposal	Direct Use	2.86 (.38)	2.57 (.53)	1.86 (.69)	1.71 (.49)	1.86 (.38)	.33 (.52)
		Discharge	2.43 (.79)	2.57 (.53)	1.71 (.49)	2.14 (.38)	2.00 (.00)	.67 (.52)
		Irrigation	2.71 (.49)	2.57 (.53)	1.57 (.53)	1.86 (.38)	1.71 (.49)	.33 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		NPDES Permit	2.29 (.76)	3.43 (.53)	2.00 (.58)	2.57 (.53)	2.00 (.00)	.67 (.52)
		Underground Disposal	2.71 (.49)	2.86 (.69)	1.57 (.53)	1.86 (.69)	1.71 (.49)	.33 (.52)
	Flow	Flow Equalization	2.57 (.53)	2.71 (.49)	1.57 (.53)	2.00 (.00)	2.00 (.00)	.67 (.52)
		Measurement	2.29 (.76)	2.86 (.38)	2.00 (.00)	2.29 (.49)	2.00 (.00)	.67 (.52)
	Grinding	Barminutors	2.71 (.49)	2.43 (.53)	1.57 (.53)	1.71 (.49)	1.86 (.38)	.50 (.55)
		Comminutors	2.43 (.79)	2.43 (.53)	1.57 (.53)	1.86 (.38)	2.00 (.00)	.67 (.52)
Processes	Grinding	Grinders	2.43 (.79)	2.43 (.53)	1.71 (.49)	2.00 (.58)	2.00 (.00)	.67 (.52)
	Grit Removal	Aerated Grit Chambers	2.29 (.76)	2.71 (.49)	1.71 (.49)	2.14 (.69)	2.00 (.00)	.67 (.52)
		Hand-Cleaned Grit Chambers	2.29 (.76)	2.29 (.76)	1.71 (.49)	2.14 (.69)	2.00 (.00)	.67 (.52)
		Mechanically-Cleaned Grit Chambers	2.29 (.76)	2.86 (.69)	1.71 (.49)	2.14 (.69)	2.00 (.00)	.67 (.52)
		Vortex	2.57 (.53)	2.57 (.53)	1.57 (.53)	2.00 (.58)	1.86 (.38)	.33 (.52)
	Lagoons	Aerated	2.29 (.76)	2.86 (.69)	2.00 (.58)	2.43 (.53)	2.00 (.00)	.67 (.52)
		Aerobic	2.57 (.53)	2.86 (.69)	2.00 (.58)	2.29 (.49)	1.86 (.38)	.50 (.55)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Anaerobic	2.57 (.53)	3.14 (.38)	2.14 (.69)	2.29 (.49)	1.86 (.38)	.50 (.55)
		Discharging	2.29 (.76)	2.71 (.49)	2.00 (.58)	2.14 (.38)	2.00 (.00)	.50 (.55)
		Facultative	2.57 (.53)	3.14 (.38)	2.14 (.69)	2.00 (.00)	1.86 (.38)	.50 (.55)
		Total Containment	2.71 (.49)	2.86 (.38)	1.86 (.69)	2.00 (.58)	1.71 (.49)	.33 (.52)
	Screening	Bar Screens	2.43 (.79)	2.43 (.79)	1.86 (.69)	2.00 (.58)	2.00 (.00)	.67 (.52)
		Microscreen	2.43 (.79)	2.43 (.79)	1.86 (.69)	2.00 (.58)	2.00 (.00)	.50 (.55)
		Rotating Screens	2.71 (.49)	2.57 (.53)	2.00 (.63)	2.00 (.58)	2.00 (.00)	.33 (.52)
		Static Screen	2.71 (.49)	2.43 (.79)	1.83 (.75)	2.00 (.58)	2.00 (.00)	.50 (.55)
	Solids Handling	503 Regulations	2.29 (.76)	3.43 (.53)	2.29 (.76)	2.57 (.53)	2.00 (.00)	.67 (.52)
		Aerobic Digesters	2.29 (.76)	3.14 (.38)	2.14 (.69)	2.14 (.38)	2.00 (.00)	.67 (.52)
Processes	Solids Handling	Anaerobic Digesters	2.29 (.76)	3.43 (.53)	2.29 (.76)	2.29 (.49)	2.00 (.00)	.83 (.41)
		Composting	2.43 (.53)	3.00 (.58)	2.14 (.90)	2.14 (.69)	1.86 (.38)	.50 (.55)
		Dewatering	2.29 (.76)	2.86 (.38)	2.00 (.82)	2.14 (.69)	1.86 (.38)	.33 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Drying Beds	2.29 (.76)	2.71 (.49)	1.86 (.69)	2.00 (.58)	2.00 (.00)	.50 (.55)
		Land Application	2.29 (.76)	2.71 (.49)	1.86 (.69)	2.14 (.69)	1.86 (.38)	.33 (.52)
		Sludge Conditioning	2.29 (.76)	3.00 (.58)	1.86 (.69)	2.14 (.69)	1.86 (.38)	.50 (.55)
		Sludge Thickening	2.29 (.76)	2.71 (.49)	2.00 (.58)	2.00 (.58)	2.00 (.00)	.33 (.55)
Support Systems	Blowers and Compressors	Centrifugal	2.57 (.53)	3.29 (.49)	2.14 (.69)	2.14 (.38)	2.00 (.00)	.50 (.55)
		Positive Displacement	2.57 (.53)	3.14 (.38)	2.00 (.58)	2.14 (.38)	2.00 (.00)	.50 (.55)
	Chemical Feeders	Evaporators	2.43 (.79)	2.86 (.38)	1.71 (.76)	2.00 (.58)	1.86 (.38)	.33 (.52)
		Gas	2.43 (.79)	3.14 (.38)	2.00 (.82)	2.57 (.98)	2.00 (.00)	.67 (.52)
		Liquids	2.71 (.49)	3.00 (.00)	1.86 (.69)	2.00 (.82)	2.00 (.00)	.50 (.55)
		Slurry	2.71 (.49)	3.00 (.00)	1.86 (.69)	2.00 (.82)	2.00 (.00)	.33 (.52)
		Solids	2.71 (.49)	2.71 (.49)	1.71 (.76)	1.86 (.69)	2.00 (.00)	.50 (.55)
	Drives	Coupled	2.71 (.49)	2.86 (.69)	1.57 (.53)	1.71 (.49)	1.86 (.38)	.33 (.52)

		Direct	2.43 (.79)	2.71 (.49)	1.71 (.76)	1.86 (.69)	2.00 (.00)	.50 (.55)
Support Systems	Drives	Right Angle	2.71 (.49)	2.71 (.49)	1.71 (.76)	1.71 (.49)	1.86 (.38)	.17 (.41)
		Speed Reducer	2.43 (.79)	3.00 (.00)	1.86 (.69)	2.14 (.69)	2.00 (.00)	.33 (.52)
	Engines	Diesel	2.86 (.38)	3.00 (.58)	1.71 (.76)	1.43 (.53)	1.57 (.53)	.17 (.41)
		Gas	2.86 (.38)	3.14 (.69)	1.86 (.69)	1.57 (.53)	1.57 (.53)	.17 (.41)
		Gasoline	2.86 (.38)	3.00 (.58)	1.86 (.69)	1.57 (.53)	1.71 (.49)	.33 (.52)
	Fittings	Coupling	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
		Corporation	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
		Curb stop	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
		Plug/Caps	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
		Special	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
		Union	2.86 (.38)	2.29 (.76)	1.14 (.38)	1.57 (.79)	1.71 (.49)	.17 (.41)
	Generators	AC	2.29 (.76)	3.14 (1.07)	1.71 (.49)	2.57 (.53)	1.86 (.38)	.17 (.41)
		DC	2.29 (.76)	3.29 (.76)	1.71 (.49)	2.43 (.79)	1.86 (.38)	.17 (.41)
	HVAC	Fans	2.29 (.76)	2.86 (.69)	1.33 (.82)	1.86 (.89)	1.86 (.38)	.17 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Joints	Compression	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
		Dresser	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
		Flanged	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
Support Systems	Joints	Fused	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
		Threaded	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
		Victualic	2.83 (.41)	2.29 (.76)	1.29 (.49)	1.29 (.49)	1.71 (.49)	.17 (.41)
	Measuring and Control	Signal Generators – Kennison Nozzle	2.83 (.41)	2.80 (.45)	1.80 (.84)	1.80 (.84)	1.80 (.45)	.25 (.50)
		Signal Generators-Magnetic Flowmeter	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.86 (.38)	.50 (.55)
		Signal Generators-Parshall Flume	2.14 (.69)	3.17 (.41)	1.83 (.75)	2.33 (.82)	1.86 (.38)	.50 (.55)
		Signal Generators-Pilot Tube	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Generators-Propeller Meter	2.29 (.49)	3.00 (.63)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Generators-Proportional Weir	2.14 (.69)	3.00 (.63)	1.83 (.75)	2.33 (.82)	1.86 (.38)	.67 (.52)
		Signal Generators-Rectangular Weir	2.14 (.69)	3.00 (.63)	1.83 (.75)	2.33 (.82)	1.86 (.38)	.67 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Signal Generators-Ultrasonic	2.14 (.69)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.86 (.38)	.50 (.55)
		Signal Generators-Venturi	2.14 (.69)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.86 (.38)	.40 (.55)
		Signal Transmitters-Electric	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Transmitters-Hydraulic	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Transmitters - Mechanical	2.29 (.49)	3.00 (.63)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Transmitters-Pneumatic	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Transmitters - Telemetry	2.29 (.49)	3.17 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
Support Systems	Measuring and Control	Signal Receivers-Combination Recorders	2.29 (.49)	3.00 (.00)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Receivers-Counters	2.29 (.49)	2.83 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Receivers-Indicators	2.29 (.49)	2.83 (.41)	1.83 (.75)	2.17 (.75)	1.71 (.49)	.33 (.52)
		Signal Receivers-Log Scale Indicators	2.50 (.55)	3.00 (.00)	1.83 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Signal Receivers-Recorders	2.50 (.55)	2.83 (.41)	1.83 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Signal Receivers-Totalizers	2.33 (.82)	2.83 (.41)	1.83 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Meters- Hydraulic - Rotameter	2.33 (.82)	2.83 (.41)	1.83 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- Amp	2.50 (.84)	3.00 (.00)	2.00 (.63)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- Watt	2.67 (.52)	3.00 (.00)	2.00 (.63)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- Watt - Hour	2.67 (.52)	3.00 (.00)	2.00 (.63)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- Mult.	2.67 (.52)	3.00 (.00)	2.17 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- VOM	2.67 (.52)	3.00 (.00)	2.00 (.63)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Meters – Electrical- Megger	2.67 (.52)	3.17 (.41)	2.17 (.75)	2.00 (.63)	1.57 (.53)	.33 (.52)
		Meters – Mechanical- RPM	2.67 (.52)	3.00 (.00)	1.83 (.75)	1.83 (.75)	1.57 (.53)	.33 (.52)
		Alarms	2.33 (.82)	2.83 (.75)	1.83 (.75)	2.00 (.63)	1.86 (.38)	.67 (.52)
		Controls - Pneumatic	2.33 (.82)	2.83 (.41)	2.00 (.63)	1.83 (.75)	1.71 (.49)	.50 (.55)
		Controls - Float	2.33 (.82)	2.50 (.55)	2.17 (.75)	2.00 (.89)	1.71 (.49)	.50 (.55)
Support Systems	Measuring and Control	Controls - Hydraulic	2.33 (.82)	3.00 (.63)	2.00 (.63)	1.83 (.75)	1.71 (.49)	.50 (.55)
		Controls - Electrical	2.33 (.82)	3.17 (.75)	2.00 (.63)	1.83 (.75)	1.71 (.49)	.50 (.55)

		Controls - Telemetry	2.43 (.53)	3.17 (.41)	2.00 (.89)	2.00 (.63)	1.57 (.53)	.50 (.55)
		Controls - Timers	2.29 (.76)	2.83 (.75)	2.00 (.89)	2.00 (.63)	1.71 (.49)	.50 (.55)
	Motors	Single Phase	2.29 (.76)	3.17 (.41)	1.50 (1.05)	1.67 (.52)	1.86 (.38)	.50 (.55)
		Poly Phase	2.43 (.53)	3.17 (.41)	1.50 (1.05)	1.83 (.75)	1.71 (.49)	.33 (.52)
		Variable Phase	2.29 (.76)	3.17 (.41)	1.50 (1.05)	1.83 (.75)	1.86 (.38)	.50 (.55)
	Odor Control	Biofilters	2.29 (.76)	3.00 (.58)	1.86 (.69)	1.86 (.69)	1.86 (.38)	.50 (.55)
		Chemical Additives	2.29 (.76)	2.86 (.38)	2.00 (.58)	1.71 (.49)	1.86 (.38)	.33 (.52)
		Scrubbers	2.29 (.76)	2.86 (.38)	1.86 (.69)	1.71 (.49)	1.86 (.38)	.50 (.55)
	Pumps	Air Lift	2.43 (.79)	2.71 (.76)	1.86 (.69)	1.71 (.49)	2.00 (.00)	.50 (.52)
		Centrifugal	2.43 (.79)	3.00 (.00)	2.00 (.58)	2.14 (.69)	2.00 (.00)	.83 (.41)
		Ejector	2.57 (.53)	3.00 (.00)	2.00 (.58)	1.86 (.38)	1.86 (.38)	.67 (.52)
		Metering	2.43 (.79)	3.00 (.00)	2.00 (.58)	1.86 (.38)	2.00 (.00)	.67 (.52)
		Positive Displacement - Diaphragm	2.43 (.79)	2.86 (.38)	2.00 (.58)	1.86 (.38)	1.86 (.38)	.50 (.55)
		Positive Displacement – Piston Plunger	2.57 (.53)	2.86 (.38)	2.00 (.58)	1.86 (.38)	1.86 (.38)	.67 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Positive Displacement – Progressive Cavity	2.57 (.53)	2.86 (.38)	2.00 (.58)	1.86 (.38)	1.86 (.38)	.50 (.55)
Support Systems	Pumps	Screw	2.43 (.79)	2.57 (.53)	1.86 (.38)	1.86 (.38)	1.86 (.38)	.50 (.55)
		Turbine	2.43 (.79)	2.86 (.69)	1.71 (.49)	2.00 (.58)	1.83 (.41)	.17 (.41)
	Rolling Stock	Generators	2.71 (.49)	2.57 (.79)	1.29 (.49)	1.71 (.49)	1.50 (.55)	.17 (.41)
		Lawn Mowers	2.71 (.49)	1.86 (.90)	1.57 (.79)	1.43 (.53)	1.50 (.55)	.17 (.41)
		Loaders	2.71 (.49)	2.43 (.98)	1.14 (.38)	1.71 (.49)	1.50 (.55)	.17 (.41)
		Portable Pumps	2.57 (.53)	2.00 (.89)	1.29 (.49)	1.57 (.53)	1.50 (.55)	.17 (.41)
		Service Vehicles	2.86 (.38)	1.67 (.82)	1.43 (.53)	1.43 (.53)	1.50 (.55)	.17 (.41)
		Trucks	2.86 (.38)	1.83 (.75)	1.43 (.53)	1.43 (.53)	1.50 (.55)	.17 (.41)
	Safety Equipment	First Aid/ Hygiene	2.00 (.58)	2.14 (.90)	1.43 (.53)	1.86 (.90)	1.86 (.38)	.67 (.52)
		Hazard Detectors	2.00 (.58)	2.57 (.79)	1.71 (.49)	2.29 (.76)	2.00 (.00)	.83 (.41)
		Personal Protection Equipment	2.00 (.58)	2.43 (.79)	1.86 (.69)	2.29 (.49)	2.00 (.00)	1.00 (.00)
		Traffic Control	2.43 (.53)	2.29 (.95)	1.43 (.53)	2.00 (.58)	1.86 (.38)	.83 (.41)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Valves	Air Release	2.33 (.82)	2.14 (.38)	1.43 (.53)	1.71 (.49)	1.86 (.38)	.50 (.55)
		Altitude	2.50 (.55)	2.43 (.53)	1.43 (.53)	1.71 (.49)	1.71 (.49)	.33 (.52)
		Ball	2.33 (.82)	2.00 (.58)	1.43 (.53)	1.86 (.69)	1.86 (.38)	.50 (.55)
		Butterfly	2.50 (.84)	2.00 (.58)	1.43 (.53)	1.86 (.69)	1.71 (.49)	.50 (.55)
		Check	2.33 (.82)	2.00 (.58)	1.43 (.53)	1.86 (.69)	1.86 (.38)	.67 (.52)
Support Systems	Valves	Foot	2.57 (.53)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.57 (.53)	.33 (.52)
		Gate	2.43 (.79)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.71 (.49)	.50 (.55)
		Globe	2.57 (.53)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.57 (.53)	.33 (.52)
		Mud	2.57 (.53)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.57 (.53)	.33 (.52)
		Multiport	2.57 (.53)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.57 (.53)	.17 (.41)
		Petcock	2.57 (.53)	2.00 (.58)	1.43 (.53)	1.43 (.53)	1.57 (.53)	.17 (.41)
		Plug	2.43 (.79)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.71 (.49)	.50 (.55)
		Pressure Control	2.43 (.79)	2.14 (.38)	1.43 (.53)	1.57 (.53)	1.86 (.38)	.33 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Sluice Gate	2.43 (.79)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.71 (.49)	.33 (.52)
		Telescoping	2.43 (.79)	2.00 (.58)	1.43 (.53)	1.57 (.53)	1.71 (.49)	.33 (.52)
		Vacuum Relief	2.43 (.79)	2.29 (.49)	1.43 (.53)	1.57 (.53)	1.86 (.38)	.17 (.41)
Public Relations		Answer Phones	1.80 (1.09)	1.67 (.82)	1.50 (.55)	2.00 (.63)	1.33 (.52)	.20 (.45)
		Customer Questions	2.40 (.89)	2.67 (.82)	1.50 (.55)	2.17 (.41)	1.67 (.52)	.60 (.55)
		Work Orders	2.60 (.55)	1.67 (.52)	1.33 (.52)	1.83 (.41)	1.67 (.52)	.40 (.55)
		Emergency Requests	2.60 (.55)	2.50 (.55)	1.50 (.55)	2.00 (.00)	1.67 (.52)	.40 (.55)
		Plant Tours	3.00 (.00)	2.00 (.89)	1.33 (.52)	1.67 (.82)	1.50 (.55)	.20 (.45)
Other	Math	Basic Calculations	1.83 (.98)	3.00 (.63)	2.17 (.41)	2.50 (.55)	2.00 (.00)	.83 (.41)
Other	Math	Advanced Calculations	2.40 (.89)	3.17 (.75)	2.67 (1.37)	2.50 (.84)	2.00 (.00)	.80 (.45)

Collection Systems Operator – ENTRY LEVEL/Class 1/Grade 1

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
General Information	Electrical	Basic Concepts	1.86 (.69)	3.14 (.69)	1.42 (.53)	3.00 (1.15)	.83 (.41)	.43 (.53)
		Math Calculations	2.14 (.90)	3.29 (.95)	1.57 (1.13)	2.14 (.90)	1.00 (.00)	.86 (.38)
	Hydraulics	Basic Concepts	2.14 (.69)	3.29 (.49)	1.86 (.69)	2.14 (1.07)	.86 (.38)	.86 (.38)
		Math Calculations	2.00 (.82)	3.29 (.49)	1.57 (.53)	2.14 (1.07)	1.00 (.00)	1.00 (.00)
	Maps/Plans	Describe Types	2.57 (.79)	2.57 (.79)	1.43 (.79)	1.57 (1.27)	.50 (.55)	.29 (.49)
		Interpretation and Use	3.00 (.00)	3.14 (1.07)	1.86 (.90)	2.29 (1.38)	.71 (.49)	.29 (.49)
	Sources and Characteristics	Characterizing Sources	2.57 (.53)	2.43 (.98)	1.86 (.90)	2.00 (1.00)	.57 (.53)	.71 (.49)
		Describe Effects	2.57 (.53)	2.57 (.79)	2.00 (.82)	2.29 (1.25)	.57 (.53)	.71 (.49)
		Identify Characteristics	2.57 (.53)	2.57 (.79)	1.86 (.69)	2.14 (1.07)	.50 (.55)	.67 (.52)
		Quality/Quantity	2.43 (.79)	2.50 (.84)	2.00 (.63)	2.33 (1.37)	.50 (.55)	.67 (.52)
	Units of Expression	Convert Units	1.43 (.53)	2.86 (.69)	1.86 (.90)	1.86 (1.07)	.86 (.38)	.86 (.38)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Define Units	1.57 (.79)	2.86 (.38)	1.71 (.76)	1.71 (.95)	.86 (.38)	.67 (.52)
Lab Tests	Materials Testing	Concrete	2.43 (.79)	2.00 (1.00)	1.14 (1.07)	1.29 (1.38)	.14 (.38)	.14 (.38)
		Piping	2.57 (.79)	2.29 (.76)	1.71 (1.11)	2.43 (1.27)	.43 (.53)	.43 (.53)
Processes	Aeration	Describe Types	2.57 (.53)	2.57 (.98)	.86 (1.07)	1.43 (1.27)	.57 (.53)	.71 (.49)
		Purpose	2.71 (.49)	2.71 (.95)	.86 (1.07)	1.71 (1.25)	.71 (.49)	.86 (.38)
	Chemical Additives	Equipment	2.14 (.38)	3.00 (.82)	1.71 (.76)	2.43 (.79)	1.00 (.00)	1.00 (.00)
		Methods	2.14 (.38)	3.00 (.82)	1.71 (.76)	2.57 (.98)	1.00 (.00)	1.00 (.00)
		Purpose	2.00 (.00)	3.29 (.76)	1.57 (.98)	2.43 (.79)	1.00 (.00)	1.00 (.00)
	Chlorination	Equipment	2.00 (.00)	2.86 (.69)	2.00 (1.15)	2.71 (1.11)	1.00 (.00)	1.00 (.00)
		Methods	2.00 (.00)	3.00 (.58)	2.00 (1.15)	2.71 (1.11)	1.00 (.00)	1.00 (.00)
		Purpose	2.00 (.00)	2.86 (.69)	1.57 (.98)	2.71 (1.11)	1.00 (.00)	1.00 (.00)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Corrosion Control	Describe	2.29 (.76)	3.00 (1.00)	1.86 (1.07)	2.14 (.90)	1.00 (.00)	.86 (.38)
		Methods	2.43 (.79)	2.86 (.69)	2.00 (1.00)	2.14 (.90)	1.00 (.00)	.71 (.49)
	Cross Connections	Definition	1.71 (.49)	3.00 (.58)	1.71 (.76)	3.57 (.53)	1.00 (.00)	1.00 (.00)
		Types of Devices	2.00 (.58)	3.14 (.38)	1.57 (.79)	3.43 (.79)	1.00 (.00)	.86 (.38)
	Flow/Velocity Measurement	Describe	2.14 (.69)	3.14 (.90)	1.86 (.90)	2.14 (1.07)	1.00 (.00)	.86 (.38)
		Flow Regulators	2.43 (.53)	3.39 (.95)	1.71 (.95)	2.14 (1.07)	1.00 (.00)	.86 (.38)
		Purpose	2.00 (.82)	2.71 (.49)	2.00 (.82)	2.86 (1.07)	1.00 (.00)	.86 (.38)
	Gravity Sewers	Describe	1.86 (.90)	2.00 (.58)	2.43 (.79)	2.43 (.98)	1.00 (.00)	1.00 (.00)
		Design/ Construction	2.14 (.69)	3.57 (.53)	1.86 (1.21)	2.29 (1.11)	.71 (.49)	.57 (.53)
		Operation/ Maintenance	2.14 (.38)	3.00 (.00)	3.00 (.82)	3.00 (1.00)	1.00 (.00)	1.00 (.00)
	Infiltration/ Inflow Devices	Concept of Sewer Rehabilitation	2.29 (.49)	2.57 (.53)	2.14 (1.07)	2.50 (1.38)	1.00 (.00)	.86 (.38)
		Describe	2.14 (.38)	2.57 (.53)	2.00 (1.15)	2.17 (1.33)	1.00 (.00)	.86 (.38)
		Methods of Inspection and Testing	2.14 (.38)	3.43 (.98)	2.57 (.53)	3.57 (.79)	1.00 (.00)	1.00 (.00)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Lift Stations	Design/ Construction	2.14 (.38)	3.57 (.53)	2.29 (1.50)	2.29 (1.60)	.86 (.38)	.71 (.49)
		Operation/ Maintenance	2.14 (.38)	3.86 (.69)	3.00 (.82)	3.57 (.53)	1.00 (.00)	1.00 (.00)
	Manholes	Describe	1.86 (.69)	2.43 (.53)	2.14 (.90)	2.43 (1.40)	.86 (.38)	.86 (.38)
		Design/ Construction	2.43 (.53)	2.57 (.53)	1.86 (1.35)	2.29 (1.25)	.86 (.38)	.57 (.53)
		Purpose	2.00 (.58)	2.43 (.53)	2.43 (1.13)	2.71 (.76)	1.00 (.00)	1.00 (.00)
	Pressure Sewers	Describe	2.14 (.69)	2.71 (.95)	1.86 (1.07)	2.43 (1.13)	1.00 (.00)	.86 (.38)
		Design/ Construction	2.00 (.00)	3.57 (1.51)	1.43 (.98)	1.71 (1.25)	.86 (.38)	.57 (.53)
		Operation/ Maintenance	2.00 (.58)	3.43 (.79)	3.29 (.76)	3.43 (.98)	1.00 (.00)	1.00 (.00)
	Sewer Equipment	Application	2.29 (.49)	2.83 (.41)	2.83 (.75)	2.83 (.98)	1.00 (.00)	1.00 (.00)
		Maintenance	2.17 (.41)	3.00 (.63)	2.67 (1.03)	3.33 (.82)	.83 (.41)	.67 (.52)
		Use/ Procedure	2.50 (.55)	3.17 (.41)	2.67 (1.03)	3.50 (.84)	.88 (.41)	.83 (.41)
	Vacuum Systems	Describe	2.71 (.49)	3.00 (.58)	1.71 (1.25)	1.86 (1.07)	1.00 (.00)	.67 (.52)
		Design/ Construction	2.43 (.79)	3.71 (1.11)	.71 (1.11)	1.71 (.95)	.71 (.49)	.14 (.38)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Operation/ Maintenance	2.71 (.49)	3.00 (.58)	2.57 (.79)	3.00 (1.15)	1.00 (.00)	.57 (.53)
Support Systems	Blowers and Compressors	Centrifugal	2.57 (.53)	2.57 (.79)	1.29 (.76)	2.00 (.58)	1.00 (.00)	.83 (.41)
		Positive Displacement	2.57 (.53)	2.57 (.79)	1.29 (.76)	2.29 (.95)	.86 (.38)	.67 (.52)
	Chemical Feeders	Liquids	2.29 (.49)	2.57 (.53)	1.43 (.53)	2.14 (.69)	.86 (.38)	.67 (.52)
		Slurry	2.29 (.49)	2.71 (.76)	1.29 (.76)	2.14 (.69)	.86 (.38)	.67 (.52)
		Solids	2.29 (.49)	2.86 (.69)	1.43 (.53)	2.14 (.69)	1.00 (.00)	.83 (.41)
	Drives	Coupled	2.57 (.53)	2.43 (.53)	1.43 (.53)	2.43 (.98)	.83 (.41)	.57 (.53)
		Direct	2.57 (.53)	2.43 (.53)	1.57 (.53)	2.43 (.98)	.83 (.41)	.43 (.53)
		Right Angle	2.43 (.53)	2.57 (.53)	1.29 (.49)	2.29 (.76)	.67 (.52)	.29 (.49)
		Speed Reducer	2.43 (.53)	2.57 (.53)	1.57 (.79)	2.29 (1.11)	.71 (.49)	.29 (.49)
	Engines	Gasoline, Diesel, and Gas	2.00 (.82)	2.71 (.49)	1.71 (.76)	2.29 (.76)	.71 (.49)	.29 (.49)
	Fittings	Corporation	2.71 (.49)	1.71 (.49)	1.71 (.76)	2.00 (.89)	.83 (.41)	.50 (.55)

		Coupling	2.71 (.49)	1.57 (.53)	1.71 (.76)	2.00 (.89)	.83 (.41)	.33 (.52)
		Curb Stop	2.71 (.49)	1.57 (.53)	1.71 (.76)	2.00 (.89)	.83 (.41)	.50 (.55)
		Plug/ Caps	2.71 (.49)	1.57 (.53)	1.71 (.76)	2.00 (.89)	.83 (.41)	.33 (.52)
		Special	2.71 (.49)	1.86 (.69)	1.71 (.76)	2.00 (.89)	.83 (.41)	.50 (.55)
		Union	2.71 (.49)	1.57 (.53)	1.71 (.76)	2.00 (.89)	.83 (.41)	.50 (.55)
	Generators	AC and DC	2.00 (.58)	2.86 (.90)	1.14 (.69)	2.57 (1.27)	.57 (.53)	.14 (.38)
	Hydrants	Basic	2.43 (.53)	2.00 (1.00)	1.00 (.58)	1.43 (.98)	.86 (.38)	.57 (.53)
	Joints	Compression	2.67 (.52)	1.83 (.75)	1.33 (.82)	2.00 (.89)	.67 (.52)	.67 (.52)
		Dresser	2.67 (.52)	1.83 (.75)	1.33 (.82)	2.00 (.89)	.67 (.52)	.67 (.52)
		Flanged	2.67 (.52)	1.67 (.82)	1.33 (.82)	2.00 (.89)	.67 (.52)	.67 (.52)
		Fused	2.50 (.55)	2.17 (1.17)	1.33 (.82)	2.00 (1.26)	.60 (.55)	2.67 (4.23)
		Threaded	2.50 (.55)	1.83 (.75)	1.33 (.82)	1.83 (.98)	.67 (.52)	.67 (.52)
		Victualic	2.67 (.52)	2.17 (1.17)	1.33 (.82)	2.00 (.89)	.67 (.52)	.67 (.52)
	Measuring and Control	Alarms	2.29 (.49)	2.71 (.76)	1.86 (.69)	3.14 (.90)	1.00 (.00)	.57 (.53)
		Controls - Pneumatic	2.29 (.49)	3.14 (.38)	1.57 (.53)	2.71 (.76)	1.00 (.00)	.43 (.53)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Controls - Float	2.57 (.53)	2.57 (.53)	1.86 (.69)	3.00 (.82)	1.00 (.00)	.57 (.53)
		Controls - Hydraulic	2.57 (.53)	2.71 (.49)	1.71 (.76)	2.57 (.98)	1.00 (.00)	.57 (.53)
		Controls - Electrical	2.14 (.38)	2.86 (.69)	1.86 (.69)	2.86 (.90)	1.00 (.00)	.43 (.53)
		Controls - Telemetry	2.14 (.38)	3.00 (.58)	1.71 (.76)	2.86 (.69)	1.00 (.00)	.29 (.49)
		Controls - Timers	2.43 (.53)	2.43 (.53)	1.57 (.79)	2.86 (.69)	1.00 (.00)	.57 (.53)
		Meters - Hydraulic (Rotameters)	2.43 (.53)	2.57 (.53)	1.71 (.76)	2.86 (.69)	1.00 (.00)	.57 (.53)
		Meters – Electrical (Amp)	2.14 (.38)	2.86 (.38)	1.57 (.79)	2.71 (1.11)	1.00 (.00)	.43 (.53)
		Meters – Electrical (Watt)	2.14 (.38)	2.86 (.38)	1.57 (.79)	3.00 (.89)	2.67 (4.08)	.29 (.49)
		Meters – Electrical (Watt Hour)	2.29 (.49)	2.71 (.49)	1.29 (.95)	2.29 (1.11)	.83 (.41)	.29 (.49)
		Meters – Electrical (Multi)	2.00 (.58)	2.86 (.38)	1.71 (.76)	2.71 (1.11)	1.00 (.00)	.43 (.53)
		Meters – Electrical (Multi- VOM)	2.00 (.58)	2.86 (.38)	1.28 (.95)	2.57 (.98)	.83 (.41)	.29 (.49)
		Meters – Electrical (Megger)	2.00 (.58)	2.86 (.38)	1.29 (.95)	2.57 (1.27)	.83 (.41)	.14 (.38)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Meters – Mechanical (RPM)	2.29 (.49)	3.00 (.00)	1.43 (.79)	2.14 (1.07)	1.00 (.00)	.14 (.38)
		Signal Generators – Kennison Nozzle	2.14 (.69)	3.14 (.38)	1.14 (1.07)	1.86 (1.21)	.67 (.52)	.29 (.49)
		Signal Generators – Magnetic Flowmeter	2.14 (.69)	3.14 (.38)	1.57 (.79)	2.43 (1.13)	1.00 (.00)	.57 (.53)
		Signal Generators – Parshall Flume	2.43 (.53)	3.00 (.58)	1.00 (.58)	1.86 (.69)	1.00 (.00)	.43 (.53)
		Signal Generators – Proportional Weir	2.57 (.53)	3.00 (.58)	1.00 (.58)	1.57 (.53)	.83 (.41)	.29 (.49)
		Signal Generators – Rectangular Weir	2.57 (.53)	3.00 (.58)	1.00 (.58)	1.57 (.53)	.83 (.41)	.29 (.49)
		Signal Generators – Venturi	2.57 (.53)	3.00 (.58)	1.00 (.58)	1.43 (.53)	.83 (.41)	.29 (.49)
		Signal Generators – Propeller Meter	2.57 (.53)	3.00 (.58)	1.00 (.58)	1.43 (.53)	.83 (.41)	.29 (.49)
		Signal Generators – Ultrasonic	2.57 (.53)	3.00 (.58)	1.00 (.58)	1.43 (.53)	1.00 (.00)	.43 (.53)
		Signal Generators – Pitot Tube	2.57 (.53)	3.14 (.38)	.86 (.69)	1.57 (.53)	.83 (.41)	.29 (.49)
		Signal Receivers – Counters	2.67 (.52)	2.67 (.52)	1.17 (.75)	1.83 (.75)	1.00 (.00)	.33 (.52)
		Signal Receivers - Indicators	2.50 (.55)	2.83 (.41)	1.00 (.63)	1.67 (.52)	1.00 (.00)	.33 (.52)
		Signal Receivers – Log Scale Indicators	2.50 (.55)	3.00 (.00)	1.00 (.63)	1.50 (.55)	.60 (.55)	.20 (.45)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Signal Receivers - Totalizers	2.50 (.55)	3.00 (.63)	1.00 (.63)	2.00 (1.10)	.80 (.45)	.33 (.52)
		Signal Receivers - Recorders	2.50 (.55)	3.00 (.63)	1.17 (.75)	1.83 (1.17)	.80 (.45)	.33 (.52)
		Signal Receivers – Combination Recorders	2.50 (.55)	3.00 (.63)	1.17 (.75)	1.83 (1.17)	.80 (.45)	.33 (.52)
		Signal Transmitters - Electric	2.67 (.52)	2.67 (.52)	1.00 (.63)	1.67 (.82)	.80 (.45)	.33 (.52)
		Signal Transmitters - Pneumatic	2.67 (.52)	2.67 (.52)	1.00 (.63)	1.33 (.52)	.60 (.55)	.17 (.41)
		Signal Transmitters - Hydraulic	2.67 (.52)	2.67 (.52)	1.00 (.63)	1.50 (.55)	.80 (.45)	.33 (.52)
		Signal Transmitters - Mechanical	2.67 (.52)	2.33 (.82)	.83 (.75)	1.17 (.75)	.67 (.52)	.17 (.41)
		Signal Transmitters - Telemetry	2.33 (.82)	2.83 (.75)	1.17 (.75)	1.67 (1.37)	.83 (.41)	.33 (.52)
	Motors	Poly Phase	2.29 (.49)	3.14 (.38)	1.57 (.53)	2.29 (1.11)	1.00 (.00)	.71 (.49)
		Single Phase	2.43 (.53)	2.86 (.38)	1.57 (.53)	2.29 (1.11)	1.00 (.00)	.71 (.49)
		Variable Speed	2.29 (.49)	3.29 (.49)	1.57 (.53)	2.29 (1.11)	1.00 (.00)	.71 (.49)
	Odor Control	Biofilters	2.71 (.49)	2.29 (1.11)	1.14 (.69)	1.43 (.98)	.86 (.38)	.86 (.38)
		Chemical Additives	2.71 (.49)	2.86 (.69)	1.43 (.79)	1.86 (1.07)	1.00 (.00)	.71 (.49)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Scrubbers	2.71 (.49)	2.86 (.69)	1.29 (.76)	1.43 (.96)	.86 (.38)	.57 (.53)
	Pipes	Cleaning/ Maintenance	2.86 (.38)	2.43 (.53)	2.29 (.76)	2.57 (.98)	1.00 (.00)	.86 (.38)
		Sewer Rehabilitation	2.71 (.49)	3.00 (.58)	2.00 (.82)	2.14 (1.21)	1.00 (.00)	.86 (.38)
		Types	2.29 (.76)	2.57 (.79)	1.43 (.79)	1.86 (1.07)	1.00 (.00)	.86 (.38)
	Pumps	Air Lift	2.29 (.49)	2.43 (.79)	1.29 (.95)	2.14 (1.35)	.86 (.38)	.71 (.49)
		Centrifugal	2.29 (.49)	2.86 (.38)	2.00 (.58)	2.86 (.69)	1.00 (.00)	.86 (.38)
		Ejector	2.14 (.38)	2.86 (.38)	1.86 (.38)	2.57 (.79)	1.00 (.00)	.86 (.38)
		Metering	2.29 (.49)	2.86 (.38)	1.43 (.53)	2.57 (.79)	1.00 (.00)	.86 (.38)
		Positive Displacement – Piston Plunger	2.29 (.49)	2.43 (.79)	1.29 (.95)	2.29 (.95)	.86 (.38)	.86 (.38)
		Positive Displacement – Progressive Cavity	2.33 (.52)	2.50 (.55)	1.83 (.75)	2.67 (.82)	1.00 (.00)	.86 (.38)
		Positive Displacement – Diaphragm	2.33 (.52)	2.50 (.55)	1.67 (.52)	2.83 (.75)	1.00 (.00)	.71 (.49)
		Screw	2.50 (.55)	2.67 (.52)	1.83 (.75)	2.83 (.75)	1.00 (.00)	.86 (.38)
		Turbine	2.33 (.52)	2.67 (.52)	1.67 (.52)	2.67 (.82)	1.00 (.00)	.71 (.49)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Rolling Stock	Fork Lifts	2.83 (.41)	2.17 (.98)	1.00 (.00)	2.17 (1.47)	.17 (.41)	.00 (.00)
		Generators	2.67 (.52)	2.50 (.84)	1.00 (.00)	2.50 (1.05)	.17 (.41)	.14 (.38)
		Lawn Mowers	2.67 (.82)	1.67 (.82)	.83 (.75)	2.00 (1.67)	.17 (.41)	.00 (.00)
		Loaders	3.00 (.00)	2.00 (.89)	1.17 (.41)	1.83 (1.47)	.17 (.41)	.00 (.00)
		Portable Pumps	3.00 (.00)	2.17 (.75)	2.00 (.89)	2.50 (1.22)	.33 (.52)	.29 (.49)
		Service Vehicles	3.00 (.00)	21.67 (.82)	1.33 (.82)	1.83 (1.33)	.17 (.41)	.00 (.00)
		Tractors	3.00 (.00)	2.00 (.89)	1.17 (.75)	2.00 (1.67)	.17 (.41)	.00 (.00)
		Trailers	3.00 (.00)	1.83 (.75)	1.33 (1.03)	1.83 (1.47)	.17 (.41)	.00 (.00)
		Trucks	3.00 (.00)	1.83 (.98)	1.50 (1.05)	2.00 (1.41)	.17 (.41)	.00 (.00)
	Safety Equipment	First Aid/ Hygiene	1.50 (.55)	2.33 (.52)	1.33 (.52)	2.83 (.75)	.50 (.55)	.29 (.49)
		Hazard Detection	1.83 (.41)	2.67 (.82)	2.00 (.89)	3.33 (.82)	1.00 (.00)	1.00 (.00)
		Personal Protection Equipment	1.83 (.41)	2.67 (.82)	2.50 (1.05)	3.50 (.84)	.83 (.41)	.86 (.38)
		Traffic Control	2.80 (.45)	1.83 (.75)	2.00 (.63)	2.83 (1.60)	.50 (.55)	.29 (.49)

	Transformers	Step Down	2.33 (.82)	3.17 (.75)	.80 (1.30)	2.60 (1.14)	.60 (.55)	.00 (.00)
		Step Up	2.33 (.82)	3.17 (.75)	.80 (1.30)	2.60 (1.14)	.60 (.55)	.00 (.00)
	Valves	Air Release	2.67 (.52)	2.83 (.41)	1.83 (.41)	2.17 (.75)	1.00 (.00)	.57 (.53)
		Altitude	2.67 (.52)	3.17 (.41)	1.33 (.82)	2.00 (1.10)	.83 (.41)	.57 (.53)
		Ball	2.67 (.52)	2.17 (.98)	2.00 (.63)	1.83 (.75)	1.00 (.00)	.57 (.53)
		Butterfly	2.67 (.52)	2.33 (.82)	1.67 (.52)	1.67 (.52)	.83 (.41)	.43 (.53)
		Check	2.67 (.52)	2.33 (.82)	2.00 (.63)	2.17 (1.17)	1.00 (.00)	.86 (.38)
		Foot	2.67 (.52)	2.33 (.82)	1.50 (.55)	1.33 (.52)	.83 (.41)	.57 (.53)
		Globe	2.67 (.52)	2.33 (.82)	1.50 (.55)	1.67 (.82)	1.00 (.00)	.29 (.49)
		Mud	2.67 (.52)	2.33 (.82)	1.50 (.55)	1.33 (.52)	.83 (.41)	.43 (.53)
		Multiport	2.67 (.52)	2.33 (.82)	1.50 (.55)	1.33 (.52)	.83 (.41)	.29 (.49)
		Petcock	2.67 (.52)	2.33 (.82)	1.50 (.55)	1.33 (.52)	.83 (.41)	.43 (.53)
		Plug	2.67 (.52)	2.50 (.84)	1.67 (.52)	1.50 (.55)	1.00 (.00)	.57 (.53)
		Pressure Control	2.50 (.55)	2.83 (.75)	1.50 (.55)	2.17 (1.17)	1.00 (.00)	.57 (.53)
		Sluice Gate	2.67 (.52)	2.33 (.82)	1.67 (.52)	1.67 (.82)	1.00 (.00)	.43 (.53)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Telescoping	2.67 (.52)	2.17 (.75)	1.33 (.52)	1.83 (.41)	1.00 (.00)	.57 (.53)
		Vacuum Relief	2.67 (.52)	2.50 (.55)	1.50 (.55)	2.17 (.98)	1.00 (.00)	.86 (.38)
Other	Public Relations	Answer Phones	1.75 (.96)	1.50 (1.0)	1.75 (.96)	2.75 (1.50)	.25 (.50)	.00 (.00)
		Customer Questions	2.75 (.50)	2.50 (.58)	2.25 (.50)	3.25 (1.50)	.67 (.58)	.00 (.00)
		Work Orders	2.75 (.50)	2.25 (.96)	2.50 (.58)	2.00 (1.15)	.75 (.50)	.00 (.00)
		Emergency Requests	2.50 (.58)	2.50 (.58)	1.75 (.50)	3.25 (.96)	.50 (.58)	.00 (.00)
		Plant Tours	2.50 (.58)	3.00 (1.41)	1.00 (.82)	2.25 (1.26)	.50 (.58)	.00 (.00)
	Math	Basic Calculations	1.00 (.00)	2.80 (.84)	1.80 (1.10)	2.40 (1.52)	1.00 (.00)	1.00 (.00)
		Advanced Calculations	1.60 (.55)	3.80 (1.10)	1.40 (1.14)	2.80 (.84)	1.00 (.00)	.67 (.52)

Distribution Systems Operator – ENTRY LEVEL/Class 1/Grade 1

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
General Information	Electrical	Basic Concepts	2.22 (.83)	3.11 (.78)	2.00 (1.20)	2.11 (.93)	.44 (.53)	.44 (.53)
	Hydraulic	Basic Concepts	2.00 (.71)	3.00 (1.12)	2.44 (.88)	2.13 (.99)	1.00 (.00)	1.00 (.00)
	Maps/Plans		2.44 (.88)	2.56 (.73)	2.44 (.73)	2.89 (1.05)	.56 (.53)	.33 (.50)
	Sources and Characteristics	Quality/ Quantity	2.38 (.74)	2.63 (.92)	1.75 (.89)	2.13 (1.36)	.50 (.53)	.50 (.53)
	Units of Expression	Conversion	1.56 (.73)	2.89 (1.05)	2.00 (.87)	2.22 (.97)	1.00 (.00)	1.00 (.00)
		Definition	1.89 (.78)	2.56 (1.13)	1.75 (.71)	2.25 (1.04)	.88 (.35)	1.00 (.00)
Lab Tests	Lab Tests	Disinfectant Demand	2.00 (.71)	3.33 (.87)	2.22 (.67)	2.78 (.97)	1.00 (.00)	1.00 (.00)
		Disinfectant Residual	1.78 (.67)	3.22 (.97)	2.22 (.67)	3.00 (1.12)	1.00 (.00)	1.00 (.00)
		HAA5	2.00 (.50)	3.44 (.88)	1.44 (1.01)	2.00 (1.22)	.67 (.50)	.67 (.50)
		Lead and Copper	2.11 (.60)	3.22 (.97)	1.33 (.87)	2.11 (1.36)	.67 (.50)	.56 (.53)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Orthophosphate	2.11 (.60)	3.33 (1.00)	1.22 (.83)	1.67 (1.22)	.67 (.50)	.56 (.53)
		pH	1.78 (.67)	2.67 (1.00)	1.44 (1.01)	2.11 (1.27)	.78 (.44)	.78 (.44)
		Sample Collection	2.11 (.93)	2.44 (1.01)	2.33 (.87)	2.78 (1.09)	.89 (.33)	.89 (.33)
		Temperature	2.11 (.60)	1.89 (.93)	1.44 (1.01)	1.67 (1.22)	.44 (.53)	.44 (.53)
		THM	2.13 (.64)	3.44 (.88)	1.67 (1.12)	2.33 (1.32)	.67 (.50)	.67 (.50)
		Total Coliform	1.89 (.78)	3.67 (.87)	2.22 (.97)	2.78 (.97)	.89 (.33)	.89 (.33)
Processes	Conveyance	Hydrants-Parts	2.44 (.73)	2.78 (.44)	2.44 (.88)	2.78 (.83)	.67 (.50)	.50 (.53)
		Hydrants-Flushing	2.56 (.73)	2.33 (.71)	2.22 (.83)	2.78 (1.09)	.67 (.50)	.88 (.35)
		Piping	2.44 (.73)	2.67 (.50)	2.55 (.88)	2.89 (1.05)	.78 (.44)	.75 (.46)
		Service Connections	2.44 (.73)	2.78 (.67)	2.33 (1.12)	3.00 (1.00)	.67 (.50)	.75 (.46)
		Valves	2.11 (.78)	2.89 (.60)	2.67 (.87)	3.11 (.78)	.78 (.44)	.75 (.46)
	Cross Connections	Air Gap	2.11 (.60)	2.33 (.50)	1.78 (.97)	2.56 (1.01)	.78 (.44)	.78 (.44)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Backflow	2.00 (.71)	2.78 (.67)	2.00 (1.00)	3.11 (1.05)	1.00 (.00)	1.00 (.00)
		Backpressure	2.00 (.71)	2.78 (.67)	1.89 (.93)	3.00 (1.00)	1.00 (.00)	.89 (.33)
		Backsiphonage	2.00 (.71)	2.78 (.67)	1.89 (.93)	3.11 (1.05)	1.00 (.00)	1.00 (.00)
		Cross Connection	2.00 (.71)	2.89 (.78)	1.89 (.93)	3.11 (1.05)	1.00 (.00)	1.00 (.00)
		Double Check Valve Assemble	2.22 (.44)	2.78 (.97)	1.78 (.97)	1.88 (.64)	.56 (.53)	.44 (.53)
		Reduced Pressure Principle Assembly	2.22 (.44)	2.89 (1.05)	1.78 (.97)	2.00 (.76)	.44 (.53)	.44 (.53)
		Vacuum Breakers	2.22 (.67)	2.44 (1.01)	1.67 (1.00)	2.67 (1.12)	.67 (.50)	.44 (.53)
	Disinfection	Lines	2.00 (.71)	3.11 (1.05)	2.56 (1.01)	3.56 (.73)	.89 (.33)	.89 (.33)
		Tanks	2.22 (.83)	2.78 (.97)	2.22 (1.09)	3.22 (.83)	.89 (.33)	.89 (.33)
	Leak Detection and Repair	Pressure Devices	2.44 (.88)	2.67 (.87)	2.11 (.93)	2.44 (.73)	.67 (.50)	.67 (.50)
		Sonice Devices	2.56 (.73)	2.78 (.97)	1.78 (.83)	2.22 (.67)	.44 (.53)	.44 (.53)
		Visual	2.38 (.92)	2.63 (.92)	2.38 (.92)	2.50 (.93)	.22 (.44)	.38 (.52)
		Volume	2.25 (.89)	2.75 (.71)	1.88 (.83)	2.50 (.76)	.50 (.53)	.63 (.52)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
	Metering	Differential Pressure	2.22 (.83)	3.00 (.87)	1.78 (.97)	2.33 (1.00)	.67 (.50)	.56 (.53)
		Displacement	2.11 (.78)	2.78 (1.09)	2.00 (1.00)	2.33 (.87)	.78 (.44)	.56 (.53)
		Velocity	2.11 (.78)	2.89 (.60)	2.11 (1.05)	2.44 (1.13)	.78 (.44)	.56 (.53)
	Pressure Control	Booster Pumps	2.33 (.87)	2.78 (.83)	1.89 (1.05)	2.33 (1.12)	.67 (.50)	.67 (.50)
		Regulators & Gauges	2.33 (.87)	2.78 (.83)	2.00 (1.00)	2.11 (1.05)	.78 (.44)	.67 (.50)
	Storage	Elevated Tanks	2.22 (.83)	2.56 (.73)	2.11 (1.05)	2.67 (1.00)	.78 (.44)	.78 (.44)
		Ground Tanks	2.22 (.83)	2.56 (.73)	2.11 (1.05)	2.67 (1.00)	.78 (.44)	.78 (.44)
		Hydropneumatic Pressure Tanks	2.22 (.83)	2.89 (.78)	1.56 (1.24)	2.22 (1.09)	.67 (.50)	.56 (.53)
		Standpipes	2.22 (.83)	2.56 (.73)	2.11 (1.05)	2.67 (1.00)	.78 (.44)	.78 (.44)
Support Systems	Cathodic Protection Devices	Anode Rod/Bags	2.33 (.71)	3.11 (1.05)	1.11 (.78)	2.22 (1.09)	.67 (.50)	.44 (.53)
		Cathode Rod/Bags	2.33 (.71)	3.11 (1.05)	1.11 (.78)	2.22 (1.09)	.67 (.50)	.44 (.53)
		Dissimilar Metals	2.00 (.71)	3.00 (1.00)	1.56 (.73)	2.44 (1.01)	.78 (.44)	.67 (.50)

		Galvanic Corrosion	2.22 (.67)	3.22 (.97)	1.67 (.87)	2.44 (1.01)	.78 (.44)	.67 (.50)
		Rectifiers	2.50 (.53)	4.22 (3.46)	1.11 (.78)	2.00 (1.12)	.56 (.53)	.44 (.53)
	Chemical Feeders	Booster Chlorinator	2.11 (.60)	3.11 (.60)	2.22 (1.09)	3.11 (1.05)	.78 (.44)	.75 (.46)
		Gas	2.00 (.50)	3.11 (.60)	2.33 (1.22)	3.11 (1.05)	.78 (.44)	.75 (.46)
		Hypochlorinators	2.00 (.50)	3.22 (.67)	2.22 (1.30)	3.00 (1.00)	.78 (.44)	.63 (.52)
	Drives	Coupled	2.56 (.53)	2.89 (.93)	1.33 (.71)	1.78 (.83)	.38 (.52)	.38 (.52)
		Direct	2.56 (.53)	2.89 (.93)	1.33 (.71)	1.78 (.83)	.38 (.52)	.38 (.52)
	Fittings	Corporation	2.44 (.73)	1.89 (.60)	2.56 (.88)	2.33 (1.12)	.56 (.53)	.67 (.50)
		Coupling	2.44 (.73)	1.89 (.60)	2.56 (.88)	2.33 (1.12)	.56 (.53)	.67 (.50)
		Curb Stop	2.44 (.73)	1.78 (.67)	2.44 (1.01)	2.22 (1.20)	.56 (.53)	.67 (.50)
		Plug/Caps	2.44 (.73)	1.78 (.67)	2.56 (1.13)	2.22 (1.20)	.56 (.53)	.67 (.50)
		Union	2.44 (.73)	1.78 (.67)	2.56 (1.13)	2.22 (1.20)	.56 (.53)	.67 (.50)
	Generators	AC	2.56 (.53)	3.00 (1.12)	1.11 (.78)	1.44 (.73)	.11 (.33)	.33 (.5)
	Joints	Compression/ Dresser	2.38 (.74)	2.00 (.71)	2.11 (1.17)	2.22 (1.20)	.56 (.53)	.67 (.50)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Flanged	2.38 (.74)	2.00 (.53)	2.13 (1.25)	2.50 (1.07)	.75 (.46)	.75 (.46)
		Gas	2.29 (.76)	2.14 (.69)	2.00 (1.41)	2.57 (1.13)	.57 (.53)	.57 (.53)
		Threaded	2.38 (.74)	2.13 (.64)	2.00 (1.31)	2.50 (1.07)	.50 (.53)	.50 (.53)
	Measuring and Control	Alarms	2.63 (.74)	2.13 (.99)	1.13 (.99)	2.00 (1.20)	.13 (.35)	.13 (.35)
		Controls-Pneumatic	2.25 (.89)	3.50 (.53)	1.50 (.93)	2.38 (1.19)	.50 (.53)	.38 (.52)
		Controls-Float	2.25 (.89)	3.00 (.93)	1.50 (.93)	2.50 (1.07)	.50 (.53)	.38 (.52)
		Controls-Hydraulic	2.25 (.89)	3.63 (.92)	1.50 (.93)	2.50 (1.07)	.50 (.53)	.38 (.52)
		Controls-Electrical	2.25 (.71)	4.00 (.53)	1.38 (.92)	2.50 (1.07)	.25 (.46)	.25 (.46)
		Controls-Telemetry	2.25 (.71)	3.88 (.64)	1.50 (.93)	2.50 (1.07)	.25 (.46)	.25 (.46)
		Controls-Timers	2.25 (.71)	3.25 (.71)	1.25 (.89)	2.38 (1.19)	.25 (.46)	.25 (.46)
		Meters – Electrical (Amp)	2.25 (.71)	3.88 (.83)	1.38 (.92)	2.25 (1.04)	.38 (.52)	.25 (.46)
		Meters – Electrical (Watt)	2.25 (.71)	3.88 (.83)	1.38 (.92)	2.25 (1.04)	.38 (.52)	.25 (.46)
		Meters – Electrical (Mutli-VOM)	2.25 (.71)	3.88 (.83)	1.38 (.92)	2.25 (1.04)	.38 (.52)	.13 (.35)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Meters – Electrical (Multi-MA)	2.25 (.71)	3.88 (.83)	1.38 (.92)	2.25 (1.04)	.38 (.52)	.13 (.35)
		Signal Generators-Magnetic Flowmeter	2.25 (.71)	3.75 (.89)	1.38 (.92)	2.13 (.83)	.25 (.46)	.25 (.46)
		Signal Generators-Venturi	2.25 (.71)	3.75 (.89)	1.38 (.92)	2.13 (.83)	.25 (.46)	.25 (.46)
		Signal Generators-Propeller Meter	2.25 (.71)	3.63 (1.06)	1.50 (.93)	2.25 (.71)	.38 (.52)	.38 (.52)
		Signal Generators-Ultrasonic	2.13 (.64)	3.50 (.53)	1.50 (1.07)	2.00 (.93)	.13 (.35)	.13 (.35)
		Signal Generators-Pilot Tube	2.13 (.64)	3.50 (.53)	1.63 (1.19)	2.00 (.93)	.13 (.35)	.14 (.38)
		Signal Receivers-Counters	2.13 (.64)	3.50 (.53)	1.63 (1.19)	2.13 (.99)	.13 (.35)	.14 (.38)
		Signal Receivers-Indicators	2.13 (.64)	3.50 (.53)	1.63 (1.19)	2.13 (.99)	.13 (.35)	.25 (.46)
		Signal Receivers-Totalizers	2.13 (.64)	3.38 (.74)	1.63 (1.19)	2.13 (.99)	.13 (.35)	.25 (.46)
		Signal Receivers-Recorder	2.13 (.64)	3.50 (.53)	1.50 (1.07)	2.00 (.93)	.13 (.35)	.25 (.46)
		Signal Transmitters-Electric	2.13 (.64)	3.50 (.53)	1.50 (1.07)	2.00 (.93)	.13 (.35)	.25 (.46)
		Signal Transmitters-Pneumatic	2.13 (.64)	3.38 (.74)	1.50 (1.07)	2.00 (.93)	.13 (.35)	.25 (.46)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Signal Transmitters-Mechanical	2.13 (.64)	3.38 (.74)	1.38 (.92)	2.00 (.93)	.13 (.35)	.25 (.46)
		Signal Transmitters-Telemetry	2.13 (.64)	3.50 (.53)	1.63 (1.19)	2.13 (.99)	.13 (.35)	.25 (.46)
	Motors	Single Phase	2.13 (.64)	3.38 (.52)	1.75 (1.39)	2.63 (.92)	.38 (.52)	.38 (.52)
		Three Phase	2.13 (.64)	3.38 (.52)	1.50 (1.31)	2.63 (.92)	.38 (.52)	.38 (.52)
		Variable Speed	2.13 (.64)	3.38 (.92)	1.38 (1.19)	2.50 (.93)	.38 (.52)	.25 (.46)
	Pipes	Abestos Cement	1.88 (.83)	2.25 (.46)	2.38 (1.19)	2.75 (1.04)	.88 (.35)	.88 (.35)
		Ductile Iron	1.88 (.83)	2.25 (.46)	2.38 (1.19)	2.88 (.99)	.88 (.35)	.88 (.35)
		PVC	2.11 (.78)	2.33 (.50)	2.56 (1.01)	2.78 (.97)	.78 (.44)	.78 (.44)
	Pumps	Centrifugal	2.00 (.87)	3.11 (.78)	1.78 (.83)	2.22 (1.09)	.89 (.33)	.78 (.44)
		Metering	2.00 (.87)	3.00 (.71)	1.78 (.83)	2.44 (1.01)	1.00 (.00)	1.00 (.00)
		Positive Displacement - Piston Plunger	2.11 (.93)	2.89 (.78)	1.56 (.73)	2.22 (1.09)	.78 (.44)	.78 (.44)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Positive Displacement - Diaphragm	2.11 (.93)	3.00 (.71)	1.56 (.73)	2.22 (1.09)	.78 (.44)	.78 (.44)
		Turbine	2.11 (.93)	3.22 (.67)	1.67 (.71)	2.00 (1.12)	.78 (.44)	.78 (.44)
	Rolling Stock	Generators	2.33 (.87)	2.67 (.71)	1.44 (.73)	2.00 (.53)	.44 (.53)	.33 (.50)
		Lawn Mowers	2.44 (.88)	1.56 (.88)	1.38 (1.06)	1.13 (.83)	.00 (.00)	.00 (.00)
		Loaders	2.44 (.88)	2.22 (.97)	1.67 (.71)	1.78 (.67)	.00 (.00)	.00 (.00)
		Portable Pumps	2.44 (.88)	2.00 (.71)	1.67 (.71)	1.78 (.67)	.22 (.44)	.00 (.00)
		Service Vehicles	2.44 (.88)	1.78 (.67)	2.00 (1.00)	1.89 (1.05)	.00 (.00)	.00 (.00)
		Trucks	2.22 (.97)	1.67 (.71)	2.00 (1.00)	1.89 (1.05)	.00 (.00)	.00 (.00)
	Safety Equipment	Confined Space	2.11 (.60)	2.67 (1.00)	2.11 (1.27)	2.89 (1.05)	.78 (.44)	.78 (.44)
		First Aid/Hygiene	2.00 (.71)	2.22 (.67)	1.78 (1.30)	2.78 (.97)	.56 (.53)	.44 (.53)
		Hazard Detection	2.11 (.60)	2.33 (.87)	2.00 (1.22)	2.78 (1.09)	.78 (.44)	.67 (.50)
		Personal Protection Equipment	2.11 (.60)	2.22 (.67)	2.44 (1.24)	2.89 (1.17)	.67 (.50)	.67 (.50)
		Traffic Control	2.44 (.88)	2.22 (.67)	2.33 (1.12)	3.33 (.87)	.56 (.53)	.67 (.50)

	Security	Attack-Prevention	2.50 (.76)	2.56 (1.13)	1.22 (1.09)	2.22 (1.09)	.22 (.44)	.33 (.50)
		Attack-Detection	2.50 (.76)	2.44 (1.01)	1.22 (1.09)	2.22 (1.09)	.11 (.33)	.22 (.44)
		Attack-Recovery	2.50 (.76)	2.44 (1.01)	1.22 (1.09)	2.22 (1.09)	.11 (.33)	.11 (.33)
	Valves	Air Release	2.11 (.78)	2.78 (.67)	2.11 (.93)	2.44 (.88)	.78 (.44)	.78 (.44)
		Altitude	2.11 (.78)	3.00 (.71)	2.11 (.93)	2.44 (.88)	.78 (.44)	.89 (.33)
		Ball	2.00 (.71)	2.78 (.67)	2.11 (.93)	2.56 (.88)	.89 (.33)	.89 (.33)
		Butterfly	2.00 (.71)	2.78 (.67)	2.11 (.93)	2.56 (.88)	.89 (.33)	.89 (.33)
		Check	2.00 (.71)	2.89 (.60)	2.11 (.93)	2.56 (.88)	.89 (.33)	.89 (.33)
		Foot	2.00 (.71)	2.78 (.67)	2.11 (.93)	2.44 (1.01)	.89 (.33)	.89 (.33)
		Gate	2.00 (.71)	2.78 (.67)	2.22 (.83)	2.56 (.88)	.89 (.33)	.89 (.33)
		Globe	2.00 (.71)	2.78 (.67)	2.11 (.93)	2.44 (1.01)	.89 (.33)	.89 (.33)
		Pressure Control	2.11 (.78)	3.00 (.71)	2.11 (.93)	2.67 (1.00)	.88 (.35)	.89 (.33)
		Vacuum Relief	2.11 (.78)	3.00 (.71)	2.00 (1.00)	2.44 (1.01)	.88 (.35)	.78 (.44)
Other	Public Relations	Answer Phones	2.50 (.93)	1.50 (.53)	1.00 (.93)	1.75 (1.16)	.00 (.00)	.13 (.35)
		Customer Questions	2.63 (.74)	1.63 (.74)	1.13 (.64)	2.00 (1.07)	.00 (.00)	.13 (.35)

Category	Topic	Information	Where Learned	Difficulty of Learning	Time on Task	Importance	Tght in WTTI	Cert?
		Work Orders	2.63 (.74)	1.63 (.74)	1.75 (.71)	2.25 (1.03)	.00 (.00)	.13 (.35)
		Emergency Requests	2.75 (.71)	1.86 (.90)	.86 (.69)	1.86 (1.21)	.00 (.00)	.13 (.35)
		Plant Tours	2.75 (.71)	1.57 (.53)	.63 (.52)	1.38 (1.19)	.00 (.00)	.13 (.35)
	Math	Basic Calculations	1.88 (.83)	3.25 (.46)	1.75 (.89)	2.75 (1.39)	1.00 (.00)	1.00 (.00)
		Advanced Calculations	1.88 (.64)	4.00 (.76)	1.63 (1.19)	2.50 (1.20)	.57 (.53)	.50 (.53)

Appendix D: Sample Course Content Workshop Form

WTI210: Introduction to Water Treatment Processes

WTI210: Introduction to Water Treatment Processes						
		Job Knowledge Survey Term				
Topics Taught	Points (Emphasized) 100 Total	Water	Collection	Distribution	Wastewater	Comments
Types of Water Treatment Processes	5	Process				
Sources and Characteristics	4	Sources and Characteristics				
Treatment of Water at the Source	3	Pre-Treatment (Process)				
Chemical Feeders	1	Chemical Feeders				
Sources and Characteristics	4	Sources and Characteristics				
Preliminary Treatment	9	Pre-Treatment (Process)				
Coagulation/ Flocculation	6	None				
Math	2	Math				
Chemical Feeders	1	Chemical Feeders				
Sedimentation	7	Process				
Math	2	Math				

Filtration	7	Process				
Math	2	Math				
Disinfection	7	Disinfection (Process)				
Math	2	Math				
Fluoridation	6	Fluoridation (Process)				
Math	2	Math				
Chemical Feeders	1	Chemical Feeders				
Corrosion Control	5	Corrosion Control (Process)				
Math	2	Math				
Cathodic Protection Devices	1	Cathodic Protection Devices				
Chemical Feeders	1	Chemical Feeders				
Iron and Manganese	6	Iron/Manganese Removal (Process)				
Math	2	Math				

Chemical Feeders	1	Chemical Feeders				
Lime Softening	6	None				
Math	2	Math				
Chemical Feeders	1	Chemical Feeders				
Project						
Maps and Plans	2	Maps/Plans				

Appendix E: HSRB Form



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HUMAN SUBJECTS REVIEW BOARD

In future correspondence, please refer to HS10-062, October 2, 2009

Dr. Shoenfelt
Psychology
WKU

Dr. Shoenfelt:

Your revision to the research project, *Job Knowledge Survey for Water and Wastewater Jobs*, was reviewed by the HSRB and it has been determined that risks to subjects are: (1) minimized and reasonable; and that (2) research procedures are consistent with a sound research design and do not expose the subjects to unnecessary risk. Reviewers determined that: (1) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (2) selection of subjects is equitable; and (3) the purposes of the research and the research setting is amenable to subjects' welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that you need to orient participants as follows: (1) signed informed consent is not required; (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data. (3) Appropriate safeguards are included to protect the rights and welfare of the subjects.

This project is therefore approved at the Exempt from Full Board Review.

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Sponsored Programs at the above address. Please report any changes to this approved protocol to this office. A Continuing Review protocol will be sent to you in the future to determine the status of the project. Also, please use the stamped approval forms to assure participants of compliance with The Office of Human Research Protections regulations.

Sincerely,

Paul J. Mooney, M.S.T.M.
Compliance Coordinator
Office of Sponsored Programs
Western Kentucky University



cc: HS file number Shoenfelt HS10-062

The Spirit Makes the Master

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