American Academy of Water Resources Engineers

Water Resources Engineering Body of Knowledge, Version 3
WRBOK

Abstract

The Water Resources Engineering Body of Knowledge (WRBOK) describes the knowledge and core competencies integral to achieve expertise in the practice of water resources engineering. This document articulates the Body of Knowledge for the practice of water resources engineering. The WRBOK describes the knowledge and skills required to practice water resources engineering at the expert level. The WRBOK is based on and builds upon the American Society of Civil Engineers (ASCE) Body of Knowledge 3rd edition (CEBOK3) for the practice of Civil Engineering, of which water resources engineering is a part. The WRBOK consists of five technical outcomes and four professional outcomes that go beyond the CEBOK3 requirements. The typical path to fulfill these outcomes is through a combination of baccalaureate-level work, masters-level work, mentored experience, professional experience, continued self-development, and service. The American Academy of Water Resources Engineers (AAWRE) Board of Trustees utilizes the WRBOK in the process of evaluating candidates for Board Certification in Water Resource Engineering.

Introduction

A water resources engineer (WRE) must have a broad array of technical and non-technical knowledge, abilities, skills, and attitudes. This document articulates the Body of Knowledge for the practice in the specialty area of water resources engineering. The Water Resources Engineering Body of Knowledge describes the knowledge and skills required to practice water resources engineering at the expert level. The WRBOK is based on and builds upon the American Society of Civil Engineers (ASCE) Body of Knowledge 3rd edition (CEBOK3) for the practice of Civil Engineering, of which water resources engineering is a part. The WRBOK also builds upon and updates content from the previous WRBOK (AAWRE, 2009). Leading practitioners and engineering educators realize there is a need to identify this knowledge and these skills and to articulate how they might be best acquired via a defined Water Resources Engineering Body of Knowledge. Given the expanding nature of the water resources engineering discipline and the many changes occurring today and in the future, defining a WRBOK is particularly important. The American Academy of Water Resources Engineers (AAWRE) Board of Trustees utilizes the WRBOK in the process of evaluating candidates for Board Certification in Water Resource Engineering.

The Water Resources Engineering Body of Knowledge describes the knowledge and core competencies integral to achieve expertise in the practice of water resources engineering and lead to specialty certification. The WRBOK captures the knowledge and skills for the archetypical water resources engineer that were deemed important by consensus of the AAWRE Board of Trustees. Achieving the WRBOK relies on a combination of formal undergraduate and postgraduate education, professional experience, extracurricular activities, practitioner mentoring, and peer interactions. It is not expected that every practicing water resources engineer will achieve all outcomes at the same level, but rather each educational program and each individual will follow an educational and experiential path suitable to their respective professional objectives.

Acquiring the WRBOK should lead to licensure and later could lead to specialty certification through AAWRE. The WRBOK builds on the body of knowledge appropriate for all civil engineers, then expands into areas specific and unique to water resources engineering. The WRBOK is not overly prescriptive and is outcomes-based. As does the CEBOK3 adopted for civil engineers, the outcomes are intended to help educators design curricula that provide the basis to gain the competencies needed for professional practice and licensing boards to determine the expertise required for licensure. The WRBOK provides a basis for the AAWRE to evaluate the education and experience of water resources engineers applying for Board Certification.

The third edition of the Civil Engineering Body of Knowledge (ASCE, 2019) was used as the basis to revise the WRBOK. Some concepts and ideas from Ressler and Lenox (2019) were considered in this revision. This WRBOK is consistent with ASCE Policy statement 524 on advanced credentialing (ASCE, 2022a) and ASCE Policy statement 568 on fulfilling the Civil Engineering Body of Knowledge (ASCE, 2022b). A brief revision history of the WRBOK is included in the Appendix.

Definition of Water Resources Engineering

Water resources engineering is the professional discipline for the stewardship and sustainable use of the world's water and related resources. Water resources engineers develop and apply scientific and engineering principles to plan, design, construct, manage, operate, regulate, and maintain infrastructure and programs. Water resources engineers are employed in both public and private sectors, as well as by colleges and universities.

Civil Engineering Body of Knowledge Overview and Outcomes

The third edition of the CEBOK3 is described by 21 outcomes in four categories. Each of the 21 outcomes is described by an outcome rubric, which includes the level of achievement required for entry into the practice of civil engineering at the professional level. The outcomes are listed in Table 2 in the Appendix.

The ASCE CEBOK3 specifies 21 outcomes one must achieve at various cognitive domain levels. The cognitive domain describes the development of intellectual skills, ranging from the simple recollection of specific facts to the integration and evaluation of complex ideas and concepts. There are six cognitive domain levels of achievement that are defined in ASCE (2019) and are listed below.

Level 1 – Remember: The ability to remember previously learned material.

Level 2 – Comprehend: The ability to grasp the meaning of learned material.

Level 3 – Apply: The ability to use learned material in new and concrete situations.

Level 4 – Analyze: The ability to break down learned material into its component parts so that its organizational structure may be understood.

Level 5 – Synthesize: The ability to put learned material together to form a new whole.

Level 6 – Evaluate: The ability to judge the significance and importance of learned material for a given purpose.

One can meet the CEBOK3 requirements by achieving cognitive domain Levels between 3 and 5 for the 21 outcomes (see Table 2). The CEBOK3 defines the typical pathway for fulfilling the level of achievement using four components that are listed below (ASCE, 2019 p. 8):

- **Undergraduate Education (UG):** undergraduate education leading to a bachelor's degree in civil engineering or a closely related engineering discipline, in general, from a four-year program accredited by the Engineering Accreditation Commission of ABET (EAC/ABET).
- **Postgraduate Education (PG):** postgraduate education equivalent to or leading to a master's degree in civil engineering or a closely related engineering discipline, in general, equivalent to one year of full-time study.
- **Mentored Experience (ME):** early career experience under the mentorship of a civil engineer practicing at the professional level, which progresses in both complexity and level of responsibility.
- **Self-Developed (SD):** individual self-development through formal or informal activities and personal observation and reflection.

One typical pathway to achieve the CEBOK3 is the following:

- Complete a Bachelor of Science in Civil Engineering (UG)
- Obtain Mentored Experience (ME),
- Complete Professional Licensure (PE),
- Obtain Postgraduate Education (PG),
- Perform Self-Development (SD).

Water Resources Engineering Body of Knowledge

The WRBOK focuses on a subset of nine outcomes from the 21 listed in CEBOK3. It expands the CEBOK3 to include one additional outcome – Service, and an additional component - Experience (E). The associated cognitive domain Levels of achievement are between 3 and 6 for the 10 WRBOK outcomes. These Levels exceed the CEBOK3 in several important areas that are needed for specialty certification. Achieving the WRBOK is required for specialty certification

in water resources engineering, as the CEBOK3 does not fully address outcome Levels needed for specialty certification. ASCE Policy Statements 524 (ASCE, 2022a) and 568 (ASCE, 2022b) support this.

Scope

The WRBOK is fulfilled through a combination of baccalaureate-level formal coursework and degree, masters-level formal coursework, mentored experience, professional experience, continued self-development, and service. The focus is on Post-Graduate Education (PG), Mentored Experience (ME), Experience (E), Self-Development (SD), and Service. Definitions of these five components are as follows. These definitions generally follow those from CEBOK3 (ASCE, 2019 Appendix B), with expanded definitions for PG, ME, and SD. Definitions for Experience and Service are provided; CEBOK does not define or cover these topics needed to achieve the WRBOK.

- **PG = Post-Graduate Education:** post-graduate education equivalent to or leading to a master's degree in civil engineering, specializing in water resources engineering, or a closely-related discipline, generally equivalent to one year of full time study. Development opportunities like rotation program, during pursuit of learning more about CE and finding a specialty area. Achieve equivalent to 30 hours of coursework beyond BS degree in a closely-related area. This is equivalent to one year of experience.
- **ME = Mentored Experience:** early-career experience under the mentorship of a civil engineer practicing at the professional level, which progresses in both complexity and level of responsibility. This includes early career experience, time from when they graduate, time when obtaining FE (Fundamentals of Engineering or equivalent), one to four years through obtaining their Professional Engineer (PE) License. Includes review of work by supervisor/mentor, guidance, and PG educational courses. Can include early/mid-career mentoring for advanced education, or development for leading, management, etc. Also includes mentor-led experience after obtaining a Professional Engineer (PE) License.
- **E = Experience:** career experience earned at the professional level, after obtaining PG, ME, and PE registration, that progresses in both complexity and level of responsibility, in water resources engineering. Includes independent work and supervision of other engineers.
- **SD= Self Development:** individual self-development through formal (continuing education course work) or informal activities, self-study, and personal observation and reflection. Expanding depth of expertise or expanding areas of expertise, during and/or after PG and E.
- **Service = Service to the Profession:** contribution to or giving back to the profession. Active and volunteering/performing service in professional water resources engineering organizations, such as ASCE EWRI, United States Society on Dams, American Institute of Hydrology, Engineers Without Borders, etc. - serving – recognition of what they have done throughout their career. Some examples are becoming the mentor, publishing new methods or guidelines, or transferring technology. Can also be used to evaluate Leadership and Teamwork, Lifelong Learning, and other areas.

The WRBOK requirements are to achieve Levels 4, 5, 6 in ten Outcome areas for Specialty Certification. Post Graduate formal coursework beyond a Bachelor of Science degree is a key component. Equally important to achieve is Mentored Experience, Experience, Self Development, and Service.

The traditional path to fulfilling the WRBOK requires a Bachelor of Science degree plus 30 hours of postgraduate studies in water resources engineering, science, business, public administration, or other engineering fields relevant to the practice of water resources engineering. It is recognized that licensure is not a goal of all water resources engineers; therefore, the WRBOK is designed to broadly prepare professionals for practice of water resource engineering that includes, but is not limited to, planning, design, teaching, applied or fundamental research, public administration, or operations in the specialty area.

Outcomes

There are ten outcomes and the levels of achievement range from Level 4 (Analyze) to Level 6 (Evaluate) needed to achieve the WRBOK and specialty certification in Water Resources Engineering. They are listed in Table 1 with associated Levels of Achievement. The blue shaded areas highlight the various typical pathways to achievement. The five technical outcomes exceed the CEBOK3 requirements. The four professional outcomes equal or exceed (Project Management) the CEBOK3. Given that individuals may pursue different career objectives, there are multiple pathways to achieve the WRBOK. For example, a water-resources engineer may pursue a technical path and achieve Level 6 in the five technical categories, and Level 5 in the five Professional categories.

Table 1 The WRBOK outcomes with associated levels of achievement and typical pathways to achievement indicated with blue shading

Outcome	Cognitive Domain Level of Achievement*		
	Level 4 Analyze	Level 5 Synthesize	Level 6 Evaluate
Technical			
Depth in Water Resources Engineering	PG	ME	E
Critical Thinking and Problem Solving	ME	ME	E
Experimental Methods and Data Analysis	PG	E	E
Risk and Uncertainty	PG, ME	PG, E, SD	PG, E, SD
Design	ME	ME	PG, E, SD
Professional			
Project Management	ME	E	E
Teamwork and Leadership	ME	ME	E, SD
Lifelong Learning	ME	ME	E, SD
Ethical Responsibilities	ME	ME	E, SD
Service	See text for definition		

*Legend:

PG = Post-Graduate Education	ME = Mentored Experience
E = Experience	SD = Self Development
Service = Service to the Profession	

WRBOK Technical Outcomes

There are five technical outcomes to achieve in-part the WRBOK.

Depth in Water Resources Engineering

Level 6: Evaluate solutions to complex problems that involve specialty areas appropriate to the practice of water resources engineering. This is generally achieved through Post-Graduate Education in WRE and Experience.

The candidate demonstrates progressively responsible charge in the planning, design, or operation of a complicated or complex project, or newly created knowledge or technologies and mastery in one or more of the technical specialty areas of practice forming the Body of Knowledge for Water Resources Engineering.

Given the breadth of the water resources engineering field, most professionals specialize in a subset of the field, with a basic understanding of the other areas of water resources engineering particularly as it influences their specialty. Within the area of specialization, it is expected that the engineer's formal education, including relevant post-graduate technical courses, and early years of professional practice, enable them to conceptualize and solve real world, complex problems that are often different from prior experiences. These efforts require high level critical thinking skills (evaluation, synthesis, analysis) and modern engineering tools for information management, computation and design.

Many professionals in consulting firms and government agencies work within groups that have similar traditional boundaries with titles often associated with a single medium or application within a medium. Some examples of traditional areas of specialty competence are:

- Environmental impact analysis and remediation design
- Hydrologic engineering analysis
- Hydraulic engineering modeling, analysis, and design
- Hydroelectric power generation project design and operations
- Irrigation systems analysis and design
- Project operations and management
- Basic and applied research
- Stormwater collection and control systems
- Flood control and drainage systems
- Water supply collection, transport, and distribution systems
- Wastewater collection and transport systems
- Water storage infrastructure planning, management, and operations
- Water supply planning and management
- Water quality
- Environmental restoration and management

Examples to Achieve Outcome

- Use of groundwater models and interpretation of model inputs, outputs, and limitations in real applications
- Management of complex water resources systems to meet multiple objectives such as hydropower generation, flood risk management, water supply, and others
- Have the education, experience and in-depth understanding of methods for analyzing/designing complex hydrologic, hydraulic, and sedimentation projects

Critical Thinking and Problem Solving

Level 6: Assess a set of solutions to determine the most appropriate solution to a complex problem, question, or issue relevant to water resources engineering. This is generally achieved through Post-Graduate Education in WRE and Experience.

The candidate demonstrates the skill to apply, analyze, synthesize, and evaluate information gathered from experimental methods and data analysis as a means to solve problems.

Examples to Achieve Outcome

- Identification of groundwater monitoring well locations for groundwater quality monitoring and/or contaminant transport assessment
- Develop and implement innovative solutions for unpredictable water resource challenges such as extreme storm events, infrastructure failures, and others
- Show the ability to identify and logically analyze the benefits and limitations of projects, and to systematically solve challenging issues

Experiments Methods and Data Analysis

Level 5 or 6: Evaluate (judge the value of learned material for a given purpose): Assess new experimental methods and/or the results of multiple experiments for the solution of water resources engineering problems. This is generally achieved through Post-Graduate Education in WRE and Experience.

The candidate demonstrates the application of water resources observations, testing programs, instrumentation programs, analyses, and evaluations in areas of technical depth (specialization) forming water resources engineering. The outcome of these water resources engineering evaluations should be conclusions and recommendations that meet the fundamental requirement to protect public health, safety, and welfare while meeting project needs.

Examples to Achieve Outcome

- Analysis of groundwater quality data from temporal and special perspectives
- Use of appropriate QA/QC procedures for field data collection and data analyses
- Design and conduct experiments to obtain information related to a complex problem(s), evaluate, and utilize the results to solve the problem(s)
- Systematically gather and analyze data and sources to ensure findings and conclusions result in an efficient and safe project

Risk and Uncertainty

Level 5 or 6: Integrate risk analysis into the solutions to complex water resources engineering problems. This is generally achieved through Post-Graduate Education in WRE and Experience.

The candidate demonstrates the ability to do at least one of the following: (1) analyze the modes for failure of a system engineered to protect the environment and the public health, welfare and safety and quantify the resulting consequences of such a failure, (2) design and/or operate an engineered system applying the principles of probability and statistics to uncertainties in data or knowledge to devise a risk management strategy, (3) assess the risks of various engineering alternatives and integrate this assessment into the recommendation of a risk management strategy, (4) employ quantitative tools to analyze risk and reliability.

Examples to Achieve Outcome

- Identification and addressing data variability and reliability in view of external factors
- Incorporation of uncertainty in design elements (e.g., considerations for climate change)
- Development of maintenance plans in view of projected component performance and lifetime
- Assess the failure risks of water resources infrastructure and develop a risk management strategy that addresses these risks
- Utilize quantitative tools such as Monte Carlo analysis to analyze risk and reliability
- Have evaluated risk and uncertainty due to insufficient or inaccurate data, modeling limitations, hydrological phenomena, and other features

Design

Level 6: Synthesize and develop technically relevant and appropriate designs and alternatives for solution to complex water resources engineering problems. This is generally achieved through Post-Graduate Education and Experience.

The candidate demonstrates the ability to: (1) assess the needs of the public and other stakeholders in formulating design constraints and objectives, (2) understand the design of a predictable system, component or process, (3) understand the interactions among planning, design, life-cycle assessment, construction and operational management, and (4) evaluate design proposals as part of the peer review process.

Examples to Achieve Outcome

- Design of processes for drinking water treatment to achieve desired water quality and quantity
- Design operating rules and plans for complex water resource systems that meet regulatory requirements and achieve stakeholder objectives
- Have designed hydraulic structures to safely and efficiently convey stormwater flows to minimize the impact on the natural and developed environment

WRBOK Professional Outcomes

There are four professional outcomes to achieve in-part the WRBOK.

Project Management

Level 5: Integrate components into a complete project management plan for a complex water resources engineering project, and manage projects within required scope, schedule, and budget.

The candidate demonstrates the ability to successfully prepare project management plans and manage projects within required scope, schedule, and budget.

Examples to Achieve Outcome

- Development of detailed cost estimates for project tasks
- Development of plans showing itemized allocation of project personnel time for project tasks
- Develop and implement plans to manage projects within scope, schedule, and budget
- Develop and implement contingency plans to respond to unanticipated changes in a project
- Be experienced in effectively managing project schedules, budgets, scopes, and multi-disciplinary team while maintaining effective coordination with clients and stakeholders

Teamwork and Leadership

Level 5: Integrate concepts and principles of effective teamwork and leadership, including diversity and inclusion, into the solutions of water resources engineering problems. **Advocate** for teamwork, leadership, diversity, and inclusion.

The candidate demonstrates through references the technical, professional and community activities the ability to participate on and lead teams, effect change, and contribute to the advance of the profession.

The candidate demonstrates through references that he or she displays effective teamwork and leadership, including support of diversity and inclusion.

Examples to Achieve Outcome

- Development of project organization plans and task responsibility assignments for project personnel based on qualifications and skills
- Monitoring project progress and accomplishments of planned milestones
- Effectively lead or participate in a multi-disciplinary team on challenging projects
- Demonstrate the ability to make critical decisions that will maintain project schedules, avoid risks, and include input from team members

Lifelong Learning

Level 5 or 6: Evaluate the effectiveness of additional knowledge, skills, and attitudes acquired through self-directed learning. Advocate for lifelong learning in the practice of water resources engineering.

The candidate demonstrates how his or her continuous effort to learn and contribute to the design of complicated or complex projects, or to newly created knowledge or technologies in one or more of the technical specialty areas of practice forming the Body of Knowledge for Water Resources Engineering.

The candidate demonstrates a continuous effort and a lifelong plan to pursue learning through education, training, independent study and mentored experience, and activities in professional societies, community service, coaching, mentoring and other learning and growth activities.

Examples to Achieve Outcome

- Use and incorporation of innovative design concepts in project tasks
- Incorporate innovative techniques in planning, designing, and operation of water resource systems
- Participate in conferences and other opportunities to acquire additional expertise to maintain skills and appropriate knowledge
- Have engaged in formal and informal education focused on personal development to advance technical knowledge and/or management skills

Ethical Responsibilities

Level 5 or 6: Assess course of resolution to ethical dilemmas in complex situations. Advocate for ethical behavior in the practice of civil engineering.

The candidate demonstrates the ability to apply appropriate ethical requirements and assess ethical dilemmas to develop courses of action to address such dilemmas in complex situations and offers examples from experience.

The candidate demonstrates the understanding of the ethical responsibilities of a registered professional engineer, explains the role ethical responsibility plays in the practice of civil engineering, and offers examples from experienced in practice.

Examples to Achieve Outcome

- Decision making under conflicting objectives
- Using appropriate design standards, policies, procedures, and design guidelines
- Plan, design, and operate projects in a cost-effective manner and according to all regulatory requirements
- Have made conscientious decisions based on technical understanding and moral responsibilities that is in the best interest of the public

Service to Profession

Demonstrated contributions to or giving back to the profession. This can be shown through active and volunteering/performing service in professional water resources engineering organizations, such as ASCE EWRI, United States Society on Dams, American Institute of Hydrology, Engineers Without Borders, etc. Some examples are becoming the mentor, publishing new methods or guidelines, or transferring technology.

Example Career Paths to Achieve WRBOK

Four example career paths A through D are shown in Figure 1 to illustrate some typical ways in which one might achieve the WRBOK and apply for Board Certification as a WRE. The rungs on each career ladder (shown in blue) represent one year of experience. Education and Post Graduate Education are listed in black text with vertical black lines/bars. Experience for each path is shown with green text and lines with arrows. Three major milestones – BS in Engineering, Pass PE Exam, and Apply for Board Certification – are shown in red with thick red rungs on each career ladder.

Career A illustrates a person who obtains a BS in Engineering, has graduate-level coursework (30 semester hours) in WRE, has one year WRE experience, possesses a PE license, and has eight years of WRE experience after obtaining their PE. Career B is similar to Career A, with the person having a PhD and has eight years of WRE experience after obtaining their PE. Career C illustrates the example where one has a BS in Engineering, a PE license, and 25 years of progressive WRE experience. Career D illustrates the example in which a person does not have a BS in Engineering, gains one year of WRE experience, completes graduate-level coursework (30 semester hours) in WRE, obtains a PE license, and has eight years of WRE experience after obtaining their PE.

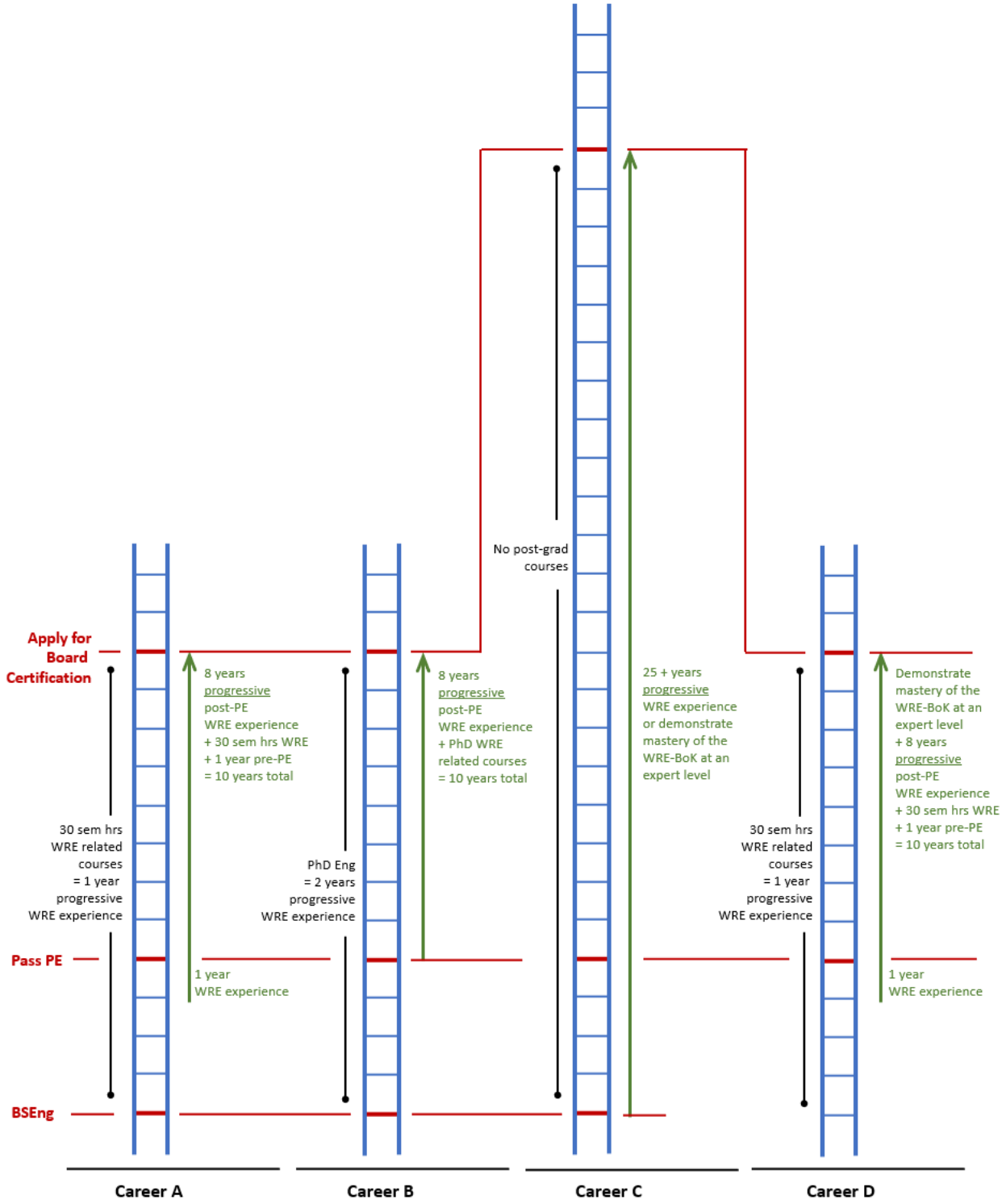

Figure 1 Example pathways to achieve the WRBOK and apply for Board Certification

References

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Appendix

This appendix contains background information from CEBOK3 and a WRBOK brief revision history.

ASCE CEBOK3 (2019)

Table 2 below is from the ASCE CEBOK3 – it presents a 'Typical' pathway to achieve the Civil Engineering body of Knowledge. It was the basis to select WRBOK Outcomes and Level of Achievement, along with the 2009 WRBOK and ideas from Ressler and Lenox (2019).

Table 2 The CEBOK3 outcomes with associated levels of achievement and typical pathways to achievement indicated (ASCE, 2019 Table F-5, pp. 111-112).

Outcome	Cognitive Domain Level of Achievement					
	Level 1 Remember	Level 2 Comprehend	Level 3 Apply	Level 4 Analyze	Level 5 Synthesize	Level 6 Evaluate
Foundational Outcomes						
Mathematics	UG	UG	UG			
Natural Sciences	UG	UG	UG			
Social Sciences	UG	UG	UG			
Humanities	UG	UG	UG			
Engineering Fundamentals Outcomes						
Materials Science	UG	UG	UG			
Engineering Mechanics	UG	UG	UG			
Experimental Methods and Data Analysis	UG	UG	UG	PG		
Critical Thinking and Problem Solving	UG	UG	UG	ME	ME	
Technical Outcomes						
Project Management	UG	UG	ME			
Engineering Economics	UG	UG	ME	ME		
Risk and Uncertainty	UG	UG	UG	ME		
Breadth in Civil Engineering Areas	UG	UG	UG	ME		
Design	UG	UG	UG	ME	ME	
Depth in a Civil Engineering Area	UG	UG	PG	PG	ME	
Sustainability	UG	UG	UG	ME		
Professional Outcomes						
Communication	UG	UG	UG	ME	ME	
Teamwork and Leadership	UG	UG	UG	ME	ME	
Lifelong Learning	UG	UG	UG	ME	ME	
Professional Attitudes	UG	UG	ME	ME		
Professional Responsibilities	UG	UG	ME	ME	ME	
Ethical Responsibilities	UG	UG	ME	ME	ME	

Legend:

UG = Undergraduate education – undergraduate education leading to a bachelor's degree in civil engineering or a closely-related engineering discipline, generally from a four-year ABET EAC-accredited program

PG = Post-Graduate Education – post-graduate education equivalent to or leading to a master's degree in civil engineering or a closely-related engineering discipline, generally equivalent to one year of full time study.

ME = Mentored Experience – early-career experience under the mentorship of a civil engineer practicing at the professional level, which progresses in both complexity and level of responsibility.

WRBOK Revision History

The current WRBOK revision effort reflects the CEBOK3. The revision was initiated by AAWRE Board of Directors in August 2021, with a BOK Committee led by John England. Participants and contributors included Stephen Abt, Jim Barton, Findlay Edwards, John England, Dennis Richards, and Berrin Tansel.

January 2005

The initial WRBOK was completed in January 2005, after AAWRE was established in October 2004. The WRBOK was developed to adhere to ASCE's Policy 465 - to broaden and deepen the body of knowledge for practicing engineers and to 'elevate the standards' in civil engineering. The WRBOK included 15 outcomes and four levels to achieve each outcome, described in a seven-page document. The authors are unknown, and presumably were members of the AAWRE Board of Directors.

March 2009

The WRBOK was revised in September 2008 and adopted by the AAWRE Board in March 2009. The revision was completed to reflect ASCE BOK2 (published in 2008) that included 24 outcomes and three categories for the outcomes (foundational, technical, and professional). This version of the WRBOK was a 48-page report and was prepared by Michael Ports, Darell Zimbelman, S.K. Nanda, and James Heaney.