The Complete
SWIMMING POOL
Reference
third edition

Rachel Griffiths
Tom Griffiths
To Coach Bill Campbell (8/9/1923–4/24/2014), whose personal and professional mentoring catapulted me into my career as an aquatics professional at the University of Maryland many, many years ago.

To my daughter Rachel, who by far completed most of the research and writing of this third edition. Her hard work, dedication, and attention to detail are beautifully illustrated in the text.

As she continues to motivate me and energize my efforts, may this book serve as her springboard into a long and rewarding career in aquatics.

— Dr. Tom Griffiths

To my grandmother, Esther Reines (1/28/1926–3/25/2014), who continually reminded us how our valuable work ethic would lead to success and repeatedly praised us for it.

— Rachel Griffiths
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The Complete Swimming Pool Reference, Third Edition combines technical aspects of pool operations manuals with practical information often found in water safety texts. The book is written for all those who own, operate, or otherwise work at swimming pools, including lifeguards, pool operators, pool managers, swimming coaches, diving coaches, swimming instructors, and even residential pool owners.

This book is written clearly and concisely so that even complicated topics are easy to understand. With 33 comprehensive chapters included, there is something for every aquatic professional. New chapters in the third edition include Chapter 1, A Water Safety Primer, Chapter 5, Aquatic Facility Planning and Funding, Chapter 6, Americans With Disabilities Act, Chapter 9, Improving Air Quality in Indoor Pools, Chapter 11, Ultraviolet (UV) Disinfection, Chapter 24, Shallow Water Blackout, Chapter 27, The Virginia Graeme Baker Pool and Spa Safety Act, Chapter 29, Insurance and Aquatic Risk Management, and Chapter 31, Preparing for and Coping With Emergencies.

Reviewing the latest information found in these newly added chapters should certainly place readers on the cutting edge of aquatic facility management and is of vital importance to today’s aquatic professionals. This work also includes a variety of references and resources to assist readers who wish to study a topic in greater depth.
INTRODUCTION

Swimming attracts more than 125 million participants annually; this figure represents nearly half of the U.S. population. For years, swimming has been the most popular participant sport in the United States. Only walking has surpassed its popularity in recent years.

According to the CDC, swimming is the most popular recreational activity for children and teens. The Association of Pool & Spa Professionals estimate there are nearly 10 million pools in this country. Six million are privately owned, residential pools. Homeowners maintain an additional three million hot tubs and spas. The number of public and semi-public pools in this country is approaching one million.

People frequent pools for a variety of reasons: fitness, relaxation, instruction, competition, and therapy. Today’s swimming facilities do not just accommodate lessons and lap swimmers but are multidimensional fitness and family centers serving all age groups. Many recreational amenities have been added to pools like climbing walls and slides.

During the writing of the first edition of this book in the early 1990s, the drowning rate remained fairly constant, between 7,000 to 8,000 individuals a year. Fortunately, death by drowning was actually reduced to around 5,000 annually during the writing of the second edition of this book. During the writing of this third edition, the drowning rate is now below 4,000. Even though more and more Americans are being exposed to a growing number of aquatic facilities and activities, the fact that the drowning rate is actually decreasing bodes well for our water safety programs.

Fortunately, only 10% of these drownings occur in swimming pools, but tragically almost half of these drownings involve small children. Some claim that nearly 500 drownings occur each year in guarded facilities.

Ironically, we build pools in this country to promote health, fitness, and safety, but several risks and hazards are produced with the construction of swimming facilities. This book can help maximize the health and safety benefits of aquatics while reducing hazards and risks. This third edition contains new and improved information on safe aquatic facilities and activities. Aquatic Facility Planning and Funding, ADA, Entrapments, Air Quality/UV, Insurance and Legal Liability, and Shallow Water Blackout are some of the exciting new chapters. Safe, enjoyable, and clean swimming pools should result if the guidelines in this book are followed.

There are many good texts available that can assist the swimming pool owner, operator, or other employees. Some texts are technical and written primarily for swimming pool technicians who need precise information on pool chemistry and filtration. Concerning safety, the American Red Cross along with the YMCA, Ellis & Associates, NASCO, and the StarGuard program are the leaders on lifeguarding and water safety and produce excellent works on these subjects. Residential pool owners are often referred to pamphlets published by swimming pool chemical companies that are easy to follow and understand.

The Complete Swimming Pool Reference, Third Edition, attempts to accomplish the formidable task of combining the most valuable elements of technical, practical, and water safety publications to produce a book that can be used by anyone in aquatics.

It is hoped that anyone associated with a pool, whether it be public or private, will find this book informative and helpful. The needs of homeowners, hotel/motel managers, park directors, pool operators, lifeguards, coaches, and parents are addressed. This book includes many other references and resources that will allow the reader to gain additional information concerning pools and spas. All readers will benefit from this book, from professional pool technicians who service swimming facilities to homeowners who relax in their hot tubs.

How to Use this Book

The information presented in this book progresses from very simple ideas to more complex swimming pool issues. The novice pool owner or operator may wish to concentrate on the earlier sections before moving on to the filtration and chemistry chapters. Conversely, the experienced pool person may wish to skim the initial chapters.
and spend more time on the later sections in the book. Additionally, some readers will prefer to concentrate on the maintenance and operations sections of the book, while others may want to focus on the safety and human relations portions.

Before addressing each chapter, the reader should carefully read the key terms defined at the outset of each section. Reviewing the key terms will aid the reader in attending to the most critical aspects of each chapter. Appendix B contains a “Personal Pool Profile” that can be completed so the information read can be applied directly to the reader’s particular pool.

In addition to this book, there are several other valuable sources of swimming pool and water safety information. The American Red Cross, American Swimming Pool and Spa Association, The Association of Aquatic Professionals, The Centers for Disease Control, Ellis & Associates, StarGuard, The National Aquatic Safety Company, The U.S. Consumer Product Safety Commission, The Association of Pool & Spa Professionals, National Swimming Pool Foundation, The Y, and the National Recreation and Park Association are just a few organizations that can provide the reader with additional information on swimming pools and spas. Websites can be found in Appendix A.

Every pool owner and operator must understand fully the local health codes and ordinances that regulate swimming facilities in their region. This book is not intended to replace or supersede local swimming pool regulations; *The Complete Swimming Pool Reference, Third Edition* only serves as a general guide and helpful reference for those who own or operate swimming pools and spas. The reader must also understand that many state health codes regulating swimming pools are out of date. Much of what is found in these pages is more up to date. Readers must also have a good understanding of the Model Aquatic Health Code (MAHC) and the Americans with Disabilities Act (ADA).
We introduce the third edition of the Complete Swimming Pool Reference with our latest thoughts and discoveries on water safety. We wanted to lead off with this section because most swimming pool books do not discuss this vitally important topic sufficiently. The use of life jackets in swimming pools—yes, that's right, in swimming pools—as well as the latest advances in drowning detection technologies are discussed here.

Chapter 2 contains a brief, general description of swimming pools, including a classification of different types of pools to provide a basic overview that should be particularly helpful for novices. Topics introduced include circulation, pool configurations, construction materials, finishes, decking, and equipment. Safety, signage, and supervision are also introduced in this section, and chemical balancing is mentioned briefly. These topics are discussed in greater detail later in the book.

Chapter 3 specifically addresses the residential pool. This chapter is a comprehensive treatment of private pools, and the emphasis in this chapter is on safety. Layers of protection and pool barriers are important aspects of this chapter. This chapter is primarily written for homeowners who either have pools or are considering the construction of a pool on their premises. Additionally, residential pool service technicians might find this chapter helpful. Topics such as filtration, circulation, and water chemistry will be presented in Sections II and III.

Chapter 4 discusses public pools in detail. Different types of pools are discussed, as well as construction materials and pool equipment. Ladders, lights, finishes, markers, barriers, programming, and security are covered in this section. Special considerations for outdoor pools are also discussed. Pool areas such as the entrance, locker rooms, first aid room, staff room, and concession areas are also included in this chapter. Chapters 1, 2, and 3 cover swimming pools in general terms.

We wind down this section with two new chapters. Chapter 5 deals with long-range planning and funding for new aquatic facilities, illustrating a rational and detailed approach. Chapter 6 discusses the latest updates with the Americans with Disabilities Act (ADA). This chapter illustrates the many and varied ways of improving the accessibility of your swimming facilities.
As noted in the second edition of *The Complete Swimming Pool Reference* (2003), whenever a hazard is created at the pool, it should be repaired or removed immediately. Accidents at the pool are usually the result of a combination of irresponsible actions on the part of the pool patron, inadequate supervision, and a failure to warn. In this third edition, we provide new approaches to water safety. In this chapter, we focus on strengthening supervision and supplementing supervision.

**Supervision**

These topics may be mentioned in more depth later in the book. However, this is critically important information for safety in aquatic environments and thus vital to emphasize up front. Safety at the pool is a win for everyone.

Much has changed since the publication of *The Complete Swimming Pool Reference* in 1994 and 2003. For decades, we preached that parental (adult) supervision and vigilant lifeguarding were the cornerstones of drowning prevention programs and the most important Layer of Protection. Although we still believe that close, active, continuous supervision of children by adults and lifeguards is essential, we now believe that in many cases, if not most, technology is more effective than human supervision in regard to drowning prevention. Although this may sound like heresy in some water safety circles, human error is the number one cause of accidents worldwide, and the best of supervision can be spotty. Human beings are unable to remain vigilant for extended periods of time, and distractions are a part of everyday life, particularly in our world of handheld communications and technology. We have spent years researching the role of both technology and supervision in monitoring humans and have made a recent epiphany: Parents and lifeguards will continue to fail to protect lives in the water if they continue to rely solely on the human senses to prevent drowning. This is not to assert that we should throw in the towel on supervising, training lifeguards, or improving vigilance. Vigilant supervision is still key. However, the lifeguard toolbox of safety measures must expand to include ALL of the most effective nuts, bolts, and screws for water safety. The water safety culture should shift from solely supervision to strengthening supervision AND supplementing supervision.

**Strengthening Supervision**

Strengthening supervision is detailed in Chapter 23 and Chapter 24. New cutting-edge research unveils the prevalence of internal noise and other distractions for lifeguards, in addition to the challenges of physical body blindness and cognitive body blindness. This research has led to new strategies to strengthen supervision through methods to help manage internal noise, as well as mix up scanning techniques so scanning does not become too routine and too habitual, which can lead to missing victims in the water. The Complex Quadriplex of Lifeguard Blindness® (CQLB)—the four most significant challenges lifeguards face, along with “the habit of scanning”—illuminates how critical it is to strengthen supervision. However, the CQLB also demonstrates that no matter how strong supervision becomes, it will always have limitations. Thus, supplementing supervision is dire as well.

**Supplementing Supervision: Water Safety Technology**

Fortunately, many of the technologies we recommend are inexpensive and effective. A major motivation for writing this third edition of *The Complete Swimming Pool Reference* is to change the water safety focus of “solely supervision” to a culture of supervision combined with better pool design and safer technologies for drowning detection and prevention.
Life Jackets

Repeatedly throughout this book, we will encourage readers to promote the use of life jackets in swimming pools, rather than reserving life jackets for open-water use only. We believe that if all nonswimmers would buckle up in life jackets before going into the pool with the same consistency they buckle up in seat belts when they enter automobiles, the drowning rate would drastically decline. Identifying nonswimmers and then floating them in appropriately fitting U.S. Coast Guard-approved life jackets is the cheapest and most effective life insurance policy we can offer those recreating in, on, and around ALL bodies of water. Keep in mind, we still encourage close, active, vigilant supervision by adults whenever nonswimmers are around the water, even when they are wearing life jackets.

Figure 1.1 shows a young nonswimmer excited as she gets buckled in a Note & Float™ life jacket for swim lessons. Life jackets are the cheapest, most effective form of life insurance that can be bought. As new water safety strategies and technologies are developed to keep pools safer, the use of lifesaving tools that already exist is a no-brainer. Life jackets are not new, yet they are not commonplace for pools. Life jackets save lives, so they should be used to save lives at pools as well.

Swimming pool parties are extremely popular throughout the world. Birthday pool parties are especially entertaining. Unfortunately, pool parties are not all fun and games. In fact, more than half of all drownings in guarded swimming pools occur during pool parties. For several reasons, parents, lifeguards, and other supervisors become distracted during pool parties. This is why drowning often occurs at these times. On-duty lifeguards alone cannot prevent pool drowning because in a pool party setting, lifeguards often do not know all the children and do not know who can swim and who cannot. A strong group use policy is needed for pool parties along with the Note & Float™ program.

Note & Float™ is a program that identifies swimmers and nonswimmers and floats nonswimmers in life jackets. The Note & Float™ program instructs patrons (especially children) to wear wristbands that designate swimmers and nonswimmers. Nonswimmers are required to wear a U.S. Coast Guard-approved life jacket, stay within arm’s reach of a parent, and stay in shallow water 5 ft and under. See Figure 1.2 for simple safety steps to implement a Note & Float™ program. All nonswimmers should always wear a life jacket at residential pools, at public pools, and in, on, and around open water. Swim lessons are still imperative early and often. In fact, buckling nonswimmers into life jackets helps acclimate children who otherwise would not be able to swim to the water and often is an impetus for swim lesson enrollment. All children should learn to swim, but before they can, float 'em.

Child Pool Alarms

Technology can monitor humans better than humans can monitor humans. The original Safety Turtle® is an extra layer of protection for children, which is primarily intended for children who are not supposed to be in the pool. The Safety Turtle® is a colorful turtle-shaped wristband (like a watch), with an alarm, which instantly detects immersion in water and sends a radio signal to the base station (See Figure 1.3.a). The Safety Turtle® is typically used in residential pools, and the base station, often located in the house, alerts the household with a loud, distinctive alarm. The base station also has a rechargeable battery and can be portable for use at a nonresidential pool. The Safety Turtle® was designed speci-
Locally for young children, locks in place, and can help save lives. This should be used as an extra layer of protection, supplementing (not replacing) supervision, in conjunction with self-closing, self-latching gates, among other necessary layers of protection. We will discuss the Safety Turtle® for improved emergency response in guarded pools in Chapter 4.

The SEAL swim monitoring and drowning detection system is promising new technology that detects a swimmer in distress and alerts lifeguards and parents in time to rescue the swimmer (Figure 1.3.b). The SEAL consists of a central hub that connects with SEALBands that are worn around the neck by swimmers and GUARDBands that are optionally worn by parents, caregivers, and lifeguards. The SEAL triggers visible, audible, and vibrating warnings and alarms on all devices (hub, SEALBand, GuardBands) notifying parents, lifeguards, and other swimmers to initiate a rescue.

Poseidon

For larger municipal pools, Poseidon computer-aided drowning detection systems may be used (see Figure 1.4). As of writing this edition, Poseidon technology systems have detected 22 drowning victims in guarded facilities, resulting in successful rescues. In all cases, the lifeguards initially missed the victims. However, after they were alarmed by the Poseidon system, the lifeguards responded and rescued the individuals. We will discuss the paramount need for water safety technology in-depth in Chapter 23.

Additional Layers of Protection

Swim Lessons

Somewhat surprisingly, our philosophy on swimming lessons has also shifted. After years of suggesting the best years to enroll children in swimming lessons...
was between ages 4 and 6 years, we now believe swimming lessons can be beneficial earlier and more often than originally thought. Many quality swim instructors and swim schools are hugely successful at teaching toddlers to swim before ages 1 and 2 years. After reviewing the research, we believe a good guideline for swimming lessons is “early and often,” but quality instruction is a must for safety and to get children off to a good start in the swimming pool.

Effective Signage

Although most public pools are plagued with long lists of meaningless rules and regulations that few people take the time to read, many residential pools have no signs at all. As a result, we promote a new strategy of safety signage systems that focuses on four vitally important safety warnings that can result in catastrophic injury and death if not obeyed in public and private pools. Signage should use warning shapes, symbols, and colors, with the most important rules displayed more prominently. The Big Four Rules (see Figure 1.5) include the following:

1. Please Watch Your Children,
2. No Extended Breath-Holding,
3. No Diving in Shallow Water, and

Rules that are not designed to prevent catastrophic injury, drowning, or death (some health codes, no glass on deck, shower before entering, no horseplay, etc.), but need to be posted, can still be displayed, but should be separated from the rules that help prevent fatal events.

Summary

The aquatics industry should not only continue to strengthen supervision, but also supplement with simple technologies such as life jackets. You will see many reasons in this text that illustrate why both of these components are vital to improving water safety in the future. Water safety education is also a must. This book will provide many new and innovative ways to create safer aquatic environments. We will give you plenty to talk about, so be sure to spread the water safety word!