

A wide-angle photograph of Red Rock Canyon at sunset. The foreground is filled with dark, spiky desert plants. In the background, several jagged, reddish-brown rock formations rise against a clear sky.

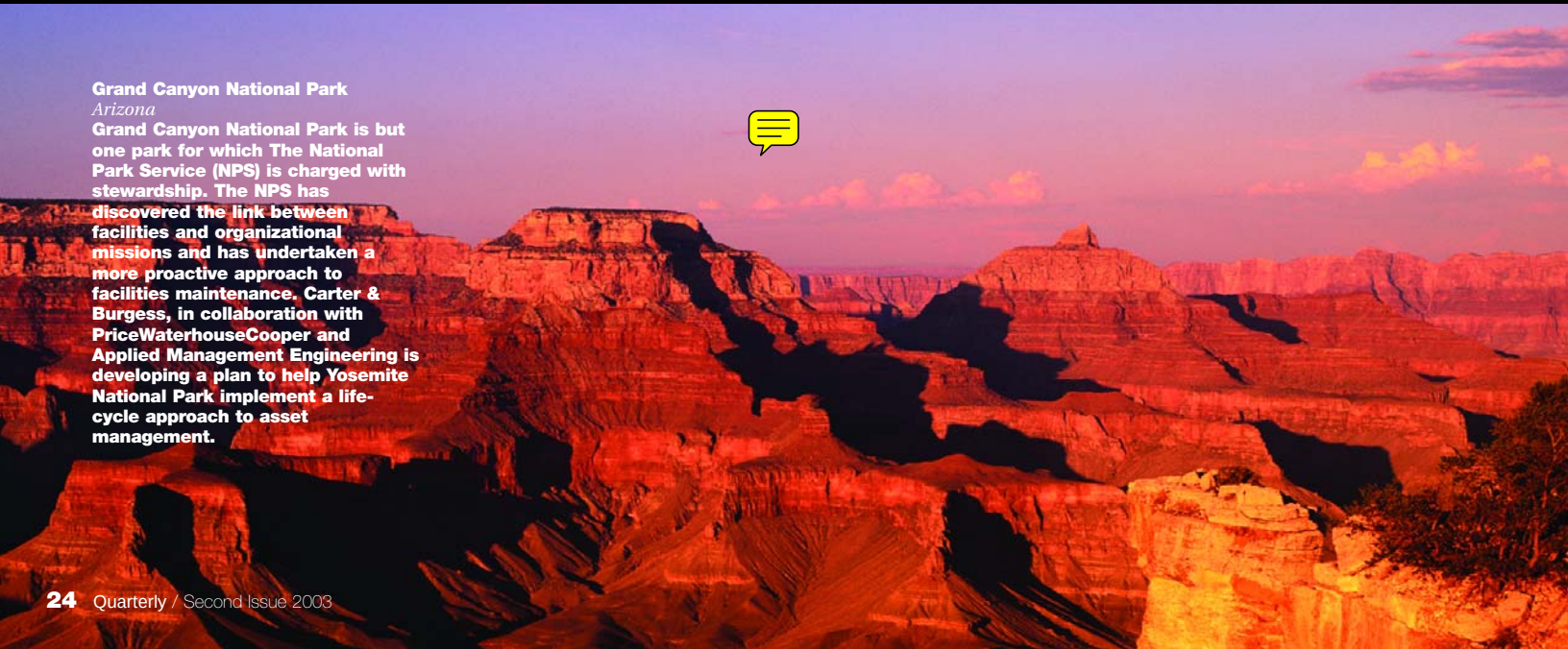
Red Rock Canyon

Outside Las Vegas, Nevada

Red Rock Canyon National Conservation Area is a popular destination for residents of Las Vegas, Nevada. National Parks across the United States are recognizing the benefits of implementing life-cycle approaches to asset management, and are turning to firms like Carter & Burgess to help them achieve their management goals.

keeping FFIT

making the business case for capital improvements

A photograph of the Grand Canyon National Park at sunset. The canyon's layered rock formations are illuminated by warm, orange and red light. A small yellow speech bubble icon is positioned in the upper right area of the image.

Grand Canyon National Park

Arizona

Grand Canyon National Park is but one park for which The National Park Service (NPS) is charged with stewardship. The NPS has discovered the link between facilities and organizational missions and has undertaken a more proactive approach to facilities maintenance. Carter & Burgess, in collaboration with PriceWaterhouseCooper and Applied Management Engineering is developing a plan to help Yosemite National Park implement a life-cycle approach to asset management.

IF MARK TWAIN were reincarnated as a modern-day federal facilities manager, he might be tempted to opine that, “everybody talks about deferred maintenance, but nobody does very much about it.”

That’s not entirely true, of course. Federal agencies have long recognized the need to improve the quality of their facilities and address maintenance that, for whatever reason, was not performed on schedule. However, the challenge of tackling this dilemma has grown more formidable with every new report about the condition of publicly owned facilities and infrastructure. In its 1998 report, *Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation’s Public Assets*, the National Research Council (NRC) concluded that while federal assets must be well maintained to operate adequately and cost effectively, significant maintenance backlogs remain a pervasive problem across the federal government.

More recently, the GAO report, *Federal Real Property: A High-Risk Area* (GAO-03-122), offered specific examples from the Department of Defense (which estimated in 2001 that it would cost \$62 billion to bring facilities up to a minimally acceptable condition), the Department of the Interior (an \$8 billion to \$11 billion deferred maintenance backlog in 2002), and the General

Services Administration (a 2002 repair backlog estimated at \$5.7 billion).

The biggest obstacle to bridging this gap has always been money. Already meager spending programs have been further stressed in recent years by ever-tightening budgets, depleted staff resources and competition with other missions and priorities. And given the current economic climate, few expect that situation to change anytime soon, if ever.

But there’s more to this story than just a perpetual cash crunch. The GAO’s *Federal Real Property* report laments the lack of reliable and useful data on the federal government’s real property assets, as well as limited experience in using data to make key decisions. And even when accuracy and expertise are available, the NRC study asserted that facilities maintenance and repair are often deemed a low priority because facility program managers do not present a good case for funding.

changes in the air

Spurred in part by President Bush’s 2002 Management Agenda, which calls for a more performance-oriented approach to government, Executive Branch agencies

are taking a fresh look at how they approach capital improvements, deferred maintenance, and other elements of their facilities management programs. What they’re finding, says Doug Kincaid, President and General Manager of Applied Management Engineering, Inc., is that examining the past tells only half the story. It is just as important to look ahead and project how those facilities will be used in the future.

“Because of the three- to five-year budget cycle, an agency may be tempted to devote a huge chunk of its budget to catch up on deferred maintenance if and when the funds become available,” explains Kincaid, a member of the review committee for the NRC’s *Stewardship* study. “That approach is short-sighted, because it overlooks the potential for future needs, changes in operations and other improvements. The agency could easily find itself in worse shape than before it started.”

Consider a typical building with an aging asphalt shingle roof and outdated electrical system, for example. A conventional maintenance approach would likely call for a new roof and electrical system as soon as funds were available. But a closer look at the owner’s long-term needs might reveal that replacing the entire facility in five or ten years makes more economic and operational sense.

“That’s why it is so important to develop performance indices that identify where facilities are going,” Kincaid says. “The combination of past and future perspectives allows facilities managers to be true stewards of their assets.”

In addition, Eric Dillinger, Carter & Burgess’ national director of Facilities

and deferred maintenance



Operations and Maintenance Cost Comparison Study Bureau of Indian Affairs (BIA)

Multiple locations nationwide

The Bureau of Indian Affairs (BIA) has one of the largest and most geographically diverse school districts in the United States, with 187 educational sites serving 48,000 students in 26 states. Carter & Burgess, in conjunction with Applied Management Engineering, led a cost comparison study of facilities operated by the BIA. The study results confirmed that wise investments in facilities upgrades had significant impacts on attendance and standardized test scores. At Gila Crossing School in Arizona, attendance jumped from 60 percent to 97 percent and academic performance improved considerably after a major repair and upgrade program was implemented.

Management, says that facilities managers must also demonstrate a clear link between the condition of their assets and their organization's mission.

"Military barracks and housing facilities have never been considered plush, but does their condition affect the Armed Forces' ability to attract and retain the personnel necessary to meet its readiness requirements?" asks Dillinger, a member of the committee that authored the NRC *Stewardship* study. "Likewise, upgrades to

the Old Faithful Inn at Yellowstone National Park may justify priority funding because preserving one-of-a-kind structures is one of the Park Service's most important goals."

overcoming obstacles

However attractive and advantageous this approach may be, embracing it has not been without its challenges. (See sidebar.) Kincaid likens it to a major organizational culture shift, "Because agencies are not

used to managing at this level. It also requires a certain level of staffing to effectively manage valuable assets. This goes against the current tendency to minimize staff resources whenever possible."

For many agencies, the biggest obstacle may be one of size. "We're talking about organizations with facilities managers spread out across the country, and in some cases, around the world," Kincaid says. "You need a sound, well-structured training program that will help them to fully

the search for sensible strategies

Changing the federal government's approach to the stewardship of its vast facilities inventory cannot happen overnight. Organizations must first tackle a host of policy and procedure issues to establish both the vision and structure for a sound facilities management program. The efforts must also be carefully planned and implemented to prevent disruptions to the same activities that the new programs are designed to improve.

Still, there's little doubt that progress is being made as more agencies discover the critical link between facilities and organizational missions. One of the most recent and widely publicized examples came following the release of the GAO report, *Defense Infrastructure: Changes in Funding Priorities and Strategic Planning Needed to Improve the Condition of Military Facilities* (GAO-03-274). Alarmed by the study's finding nearly 70 percent of facility classes (including barracks, administrative centers, child care centers and warehouses) had been rated "in such poor condition that they cannot fully support military missions," the Department of Defense acted quickly to correct deficiencies in its facilities strategic plan, including having a procedure for "common condition reporting" in place by October 2004.

Carter & Burgess has played a role in helping agencies understand the value of facilities stewardship. The firm, in conjunction with Applied Management Engineering, helped lead a cost comparison study of facilities operated by the Bureau of Indian Affairs (BIA). The study was especially important for the BIA's educational system, one of the largest and most geographically diverse school districts in the

nation with 187 educational sites serving 48,000 students in 26 states.

Although the agency's O&M funding has lagged behind public- and private-sector peer groups by as much as 78 percent, there were many examples of how wise investments in facilities upgrades had made a significant difference. Among them was Gila Crossing Community School in south central Arizona, which had struggled with low attendance and poor performance on standardized tests. Following a major repair and upgrade program, the school's attendance jumped from 60 percent to 97 percent, accompanied by dramatic improvements in academic performance. Educators credited the improvements with developing pride in the school, and for encouraging more involvement among parents.

Many agencies such as the National Park Service (NPS) have found the challenge is not recognizing the need to change, but having the right tools to effect the improvements. "Most of us in the NPS realized a long time ago that we needed our concessionaires to take a more proactive approach to facilities maintenance," says Bill Rust, Facility Manager at Yosemite National Park. "In the past ten years, however, database technology changed so quickly that what we saw as a solution quickly became outdated. Without a tool to help track and prioritize facility needs, our people had no way to tell their story."

A collaboration with Carter & Burgess, PriceWaterhouseCooper and Applied Management Engineering aims to help NPS overcome some of these obstacles. The project will provide Yosemite with the management

information tools needed to implement a life-cycle approach to asset management, which in turn, will put NPS in a stronger position to negotiate concessionaire contracts. "When we began working with Carter & Burgess, we learned there was a broader spectrum of software and applications available than we realized. Now, we're better able to educate our people and build momentum for change. As they learn more about both the technology and the life-cycle approach, they realize why they need it."

Another cultural change is underway at the Bureau of Land Management (BLM), where Carter & Burgess and Applied Management Engineering is developing a comprehensive condition assessment program that will help the agency capture valuable baseline data for its vast network of recreational and administrative sites, roads, trails, bridges and dams.

"Until now, many people in BLM did not realize the complexity that a true condition assessment program entailed," says Elliot Ng, a BLM Senior Environmental Engineer and Engineering Program Leader. "Likewise, we also lacked the standardization to roll up and compare data."

Ng says that the new Carter & Burgess-developed program will have many important outcomes for BLM. "The most important, of course, will be validating what's out there," he says. "The data alone will help us make better decisions and plan more strategically for the future. Another benefit of this exercise is the opportunity to reexamine and rework our business processes, enabling us to allocate resources to those needs that will offer the most value to our facilities and the people who use them". - GNB ■

understand the concept and become forward thinkers.”

Dillinger adds that there is also a need for the proper management tools and metrics to collect, analyze, and prioritize facility conditions and needs. “These include condition assessments, management systems, productivity and performance measures that provide for comparisons across multiple functions and categories,” he says. For example, the Facility Condition Index (FCI), a standard industry benchmark, can be a valuable tool for evaluating the current and projected state of different types of facilities. But the findings must be reported and used within the proper context “to provide an accurate, relevant link between facility maintenance and organizational outcomes.”

That consideration includes making provisions for evolving trends as well as unexpected events. For example, “think about how far the infrastructure to support e-mail and file-sharing has come over the years, or how 9/11 radically changed our ideas about security in a matter of hours,” says Dillinger. “That’s why all facilities management processes require the flexibility to accommodate such developments, instead of making agencies and facility managers start again from scratch.”

fundamental first steps

The first step toward building a sound business case for facilities improvements and maintenance programs is information. An agency needs to have a complete, accurate picture of its asset inventory. That includes quantifying type, location, history, components, function, and relationship to other assets. “Making these definitions up front is critical,” Kincaid says. “Simply saying that a park has 500 miles of roads, for example, really tells you very little. You have to know how those roads are used and the type of construction.”

Next, the owner must define the types of deferred maintenance and work types that will be needed for those components in the future. This includes component renewal, life-cycle maintenance, replacement costs, and other factors. Then, it’s up to the agency to establish the processes and responsibilities for monitoring facilities by category.



NAS Fort Worth JRB Carswell Field IDC

Fort Worth, Texas

Carter & Burgess served as the Prime A/E and the Program Manager for the \$100-million Indefinite Delivery Requirements (IDR) contract at Carswell AFB. The project consisted of the development of planning, programming and construction documents associated with the realignment of the former Carswell AFB into a Navy-hosted Joint Reserve Base. The program includes 20 to 30 new facilities and major renovation to over 80 facilities. The base covers 1725.15 acres.

The next step may prove to be the most difficult—developing consistency in costing facility condition and maintenance needs in order to make relevant organization-wide comparisons. Replacing an asphalt shingle roof in Virginia would be different from performing the same task in Montana due to localized cost issues, influences of climate on life-cycle aspects and other factors. “You need to know how to adjust for these factors to make an accurate comparison,” Kincaid says. “Similar types of facilities may have significantly different functional uses that can affect life-cycle and costs.”

There is also the human factor to consider. “There will always be some degree of subjectivity in assigning costs,” Kincaid says. “You can, however, control it with well-developed processes and cost services.”

Every organization will face its own general and specific issues as they inte-

grate these and other aspects of performance-based management into the facilities programs. Some will be resolved relatively easily, while others may require careful thought, constructive debate and the assistance of skilled experts. To be sure, it is a very different way of doing things, but as Dillinger notes, it is an approach that embodies what the role of facilities management should be, not what it has been up to now.

“The time when it was acceptable to simply request funds for building or maintenance projects and hope for the best is long past,” he says. “Facility managers have a responsibility to justify not only what they do, but why they do it, using the best technologies and management practices available because they’re stewards not only of facilities, but also of taxpayers’ money. As such, they must strive to ensure that the nation’s investment in facilities is being spent wisely. Gary N. Bowen ■



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Dialing For Data

Demand For High-Speed Transmission Spurs Growth Of Wireless

The growth of wireless communications is the process of correcting an accident of history. If radio had been perfected before the telephone was invented, we might never have built the copper wire infrastructure.

Today, more than 106 million Americans have cellular telephones. That figure was only 86 million on December 31, 1999, but new subscribers are signing up at the astounding rate of more than 67,000 each day, more than one every 2 seconds. Even so, cellular subscribers in the United States account for

less than 40 percent of the population, compared to 50 percent in Japan and much of Western Europe, and more than 70 percent in regions as diverse as congested Hong Kong and sparsely populated Scandinavia. But we're gaining fast. Defying early predictions, market penetration picks up speed as the wireless subscriber base grows into the 30 percentile regions. At that point cellular telephones are seen as a necessity rather than a luxury.

The cellular telephone, a technological wonder that once was the exclusive domain of the wealthy and the powerful, has become an essential tool of our modern life and economy. Today, the telephone is poised to replace the desktop computer as the primary portal to the Internet and the many wonders of the Web.

Cellular telephones have freed us from the tyranny of the wire. They already allow us to communicate with anyone, anywhere, at any time. Soon, we may use our pocket telephones to send and receive e-mail, watch a movie and manage our bank accounts. As cellular technology evolves, the potential seems almost limitless. The industry is moving beyond the first and second generations of cellular to a more capable, more flexible third generation.

Generation Gap

The first cellular phones were analog units introduced in the United States in the early 1980s. These first-generation telephones and the networks built to support them are still the most popular in the

United States: Approximately 50 percent of U.S. cellular phone subscribers use analog devices rather than the more advanced digital models. Most cities have digital networks, but rural areas are almost exclusively analog, so phones sold in the United States must have dual analog-digital capability.

First-generation analog phones send information through radio waves that are modulated to match the user's voice. These simplest cellular systems use Frequency Division Multiplexing (FDM), which allocates a waveband to each conversation. The analog



cellular system in the United States, called AMPS (Advanced Mobile Phone Service), remains the most widespread cellular technology in the United States. It uses the 800-MHz to 900-MHz frequency spectrum, with separate 30 KHz channels for each call. This limits the number of calls to the number of 30KHz fre-

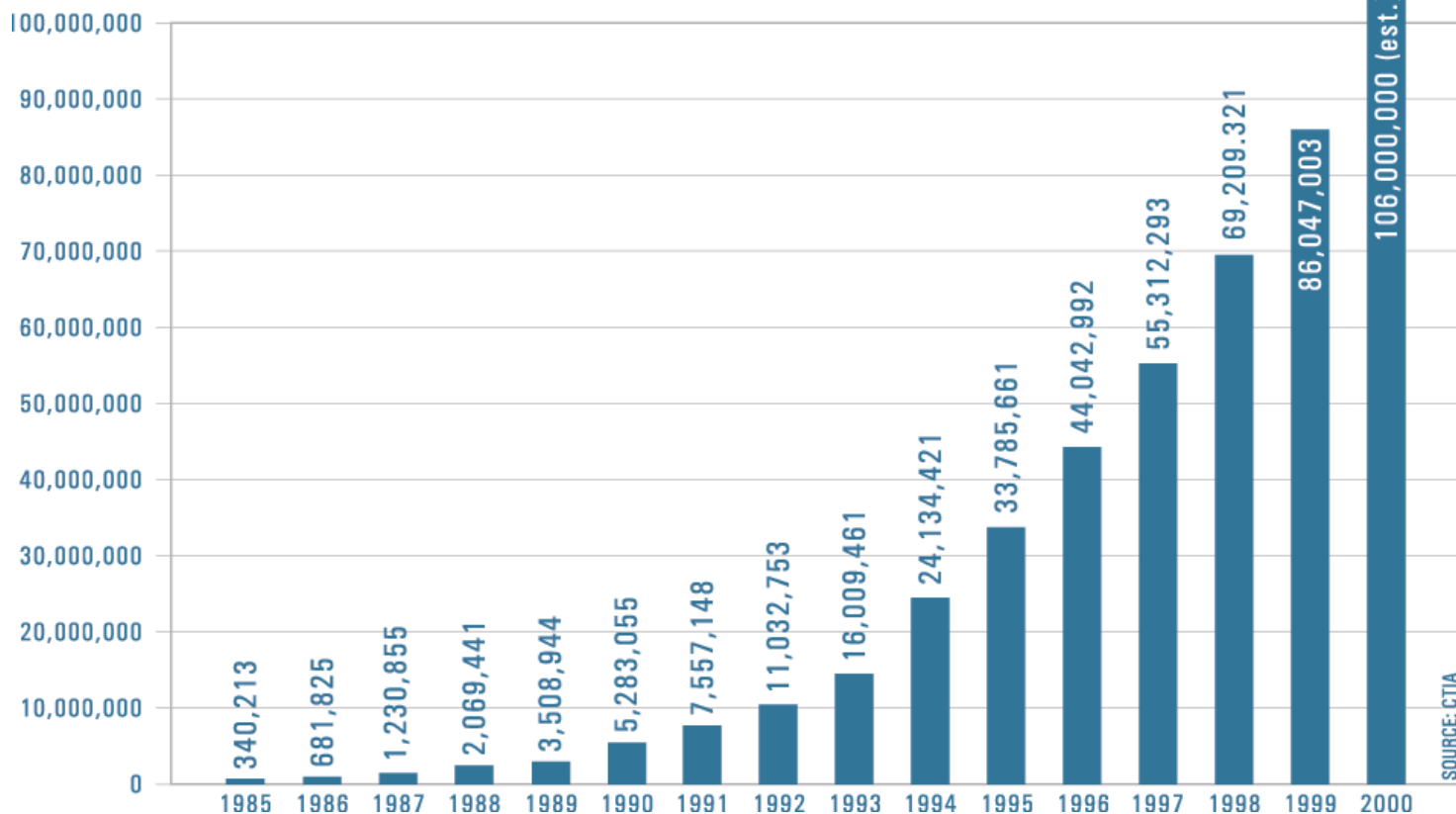
quencies available. For example, if an operator has a license for 10MHz of spectrum, it can support slightly more than 100 calls per cell.

Digital cellular phones, which convert sound waves into bits of data that are transmitted by modulated radio or microwaves, are the second generation of wireless technology. The first two generations of wireless transmit information using a technique known as circuit switching. When a customer makes a connection, a specific frequency channel is allocated to that conversation until the call is completed.

The third generation will use a different technique, packet switching, to transmit data. The speed of a wireless connection could go from today's 2G speed of 9.6 kilobits per second to as much as 2.4 megabits per second, twice as fast as the fastest wired broadband Internet service. Voice is also carried, but packet switching is essential for high-speed wireless data transmission. 3G wireless technology will eventually offer speeds up to 6½ times faster than a standard telephone connection.

Packet switching slices the signal into many discrete packets of information, each marked with the destination's address. The packets are sliced into the network, with each finding the best possible

Wireless Subscribership



Cellular use in the United States has exploded since the early 1990s, going from slightly more than 5 million customers in 1990 to more than 106 million today. More than 60,000 new subscribers sign up every day.

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route, and then reassembled in proper order at the destination end. Packet switching allows data from many different sources to co-exist on the same channel, and lets users talk on their telephones while also accessing the Internet.

Packet switching networks will be capable of providing high-resolution graphics and streaming music and video to cell phones, personal data assistants and laptop computers. Extending the telephone's capabilities with high-speed data access and transmission is the impetus behind the development of 3G wireless and related technologies.

Subscribers would be charged for the amount of data they transmit or receive, not for how long they use the system. A drawback to packet switching is latency, or the time it takes to gather and reassemble the data packets. In addition, some packets are lost and have to be re-sent, adding to transmission time. Latency is mostly a problem with voice communications rather than data transmission, so silence suppression is often used: Packets that do not contain voice data (up to 30 percent of a telephone conversation is silence) are not transmitted.

Japan, which did not allow individual ownership of cellular phones until the early 1990s and therefore

skipped the first generation of wireless completely, will be the first country to build a network infrastructure that can support the third generation of cellular telephony. European 3G networks are expected to be built in Europe by 2002 and in the United States by 2005.

Wireless data sped up to 100 times today's norm of 9.6 kbps (about the speed of a modem in 1990) is the goal of 3G technology. At these speeds, surfing the Internet will be simpler and faster with a telephone or other handheld device than with a computer equipped with a modem.

Alphabet Soup

3G is not a set of standards or specifications. It is an umbrella term that covers a variety of approaches and technologies for achieving high data transmission speeds via wireless. In most cases and countries, it will involve upgrading and improving the existing infrastructure to support the enhanced service, with capabilities added as demand increases. Hybrid systems that can support data transmission speeds to 100 kbps, often called 2.5G, will use one of a number of techniques to achieve the improvement.

Asian and European wireless systems using a

Wireless Timeline

1933 - Edwin H. Armstrong invents frequency modulation to improve radio broadcast quality. It becomes commercially available in 1935.

Late 1940s - Mobile radio telephone service is offered in some U.S. cities. New York City's network allows for 12 simultaneous conversations.

1973 - Motorola introduces the DynaTAC mobile telephone, a reasonably small radiotelephone set.

1975 - Federal Communications Commission sets the stage for cellular telephony when it allocates a portion of the radio spectrum for mobile communications.

1977 - FCC authorizes two experimental mobile telephone licenses, one to AT&T in Chicago and the other to Motorola and American Radio Telephone Service Inc. in the Baltimore/Washington corridor.

1982 -March: The FCC establishes guidelines for issuing commercial cellular licenses. October: First construction permit for a cellular radio license is

awarded to AT&T for Chicago.

1983 -October 6: AT&T receives the first cellular telephone license, authorizing service on the Chicago network it has been building since 1982. The system is turned on a week later, on October 13. October 18: FCC says licenses in all markets below the top 30 cities will be awarded by lottery.

1984 - Motorola introduces the DynaTAC 800X, the first portable cellular telephone. It weighs 2 pounds and costs \$3,995.

1986 - U.S. subscriber base reaches 500,000.

1987 -The 1 millionth cellular subscriber signs up in October. By the end of the year, the U.S. subscriber base reaches 1.2 million.

1988 - The European Union selects GSM as its cellular standard, ensuring cellular telephone compatibility in 15 countries.

1990 - By early 1990, construction permits for cellular

systems have been issued in every market in the United States.

1991 - The Motorola MicroTAC Lite, the lightest portable telephone on the market, goes on sale for \$1,000.

1992 - November 23: U.S. cellular subscriber base reaches 10 million.

1995 - Wireless competition expanded by FCC to nine licensees per area, up from two in 1983.

1996 - Telecommunications Act of 1996 essentially deregulates most segments of the telecommunications industry.

1997 - Cell phones outsell computers worldwide, 100 million to 80 million.

1998 - Cumulative capital investment in cellular infrastructure reaches \$50 billion.

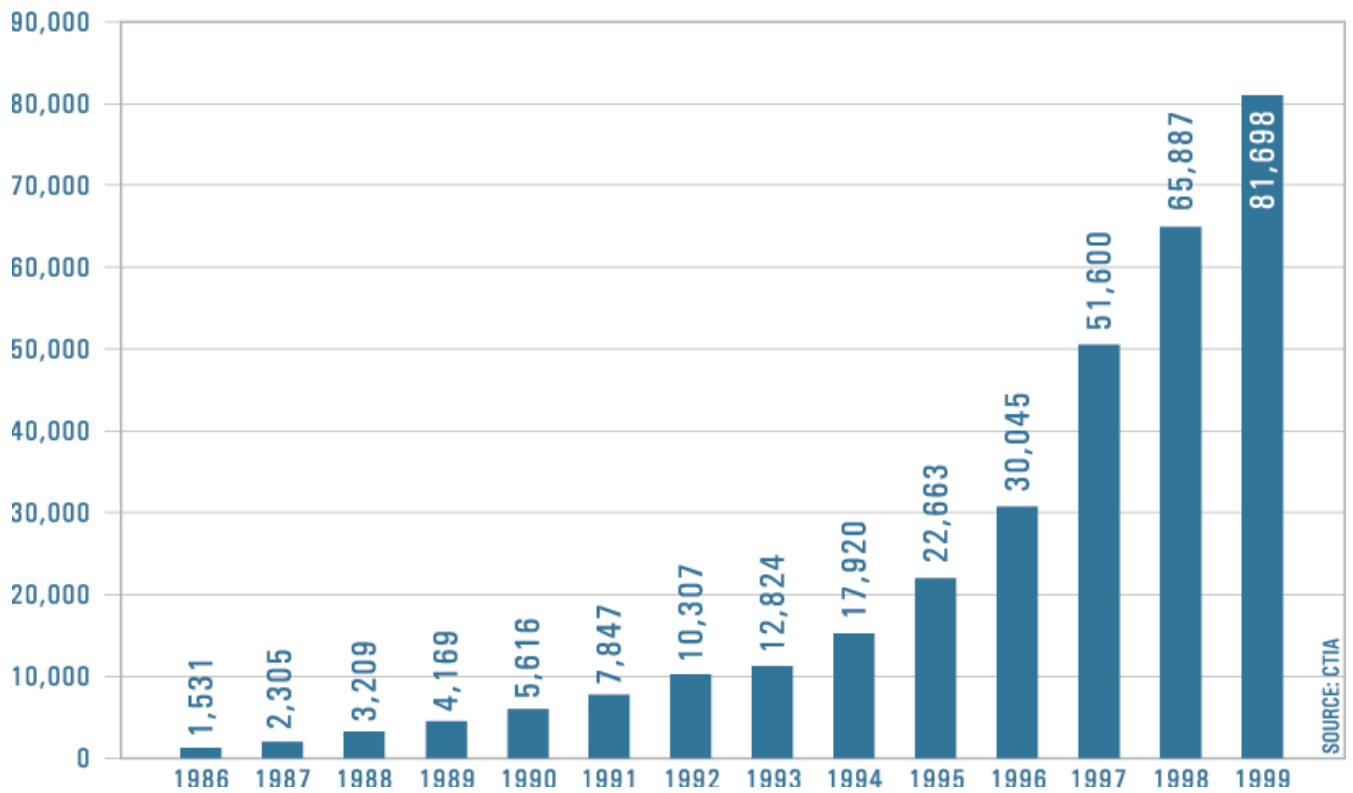
2003 - Worldwide cell phone subscribers total 1 billion?

TDMA technology called GSM (Global Standard for Mobile Communications) will probably upgrade to W-CDMA (Wideband Code Division Multiple Access). GSM, which uses TDMA with encryption features, has been adopted widely in Europe and Asia. GSM phones support Short Message Service. They can receive short text messages and can be connected to a PC to transmit data and fax messages at a rate of 9.6 Kbps.

More than half the world's wireless subscribers, in some 90 countries, use GSM, the European version of TDMA. But of the 170 million GSM users around the world, only 5 million live in North America.

In North America, there are competing technologies with different paths to 3G. Four mutually incompatible mobile technology standards in this country have resulted in a fragmented North American mar-

Cell Sites in Commercial Use



Expansion of cellular service across the United States has created demand for more cell sites to provide better, more uniform service in rural and urban areas.

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ket. Other countries with a more coherent national telecommunications policy will have an advantage in building sophisticated cellular network infrastructures, but the lag will allow the U.S. industry to learn from the mistakes of 3G pioneers.

Some U.S. and Canadian wireless providers, including Bell Atlantic, Sprint and Verizon, operate networks using a type of CDMA (Code Division Multiple Access), based on the IS-95 standard developed by Qualcomm. CDMA could provide, in theory at least, almost unlimited system capacity and high speeds.

CDMA operators will probably upgrade to W-CDMA, which is theoretically capable of 2 Mbps, even though it is substantially different from North American CDMA technology. CDMA will form the basis of future broadband systems, but transforming a CDMA network into a W-CDMA system will involve more codes, a different modulation scheme and wider bandwidths.

CDMA and W-CDMA rely on spread spectrum technology. Instead of creating time slots or subdividing the spectrum as in TDMA, CDMA sends information over multiple frequencies with each active subscriber assigned a unique code. Many signals can

share the same range of frequencies because each telephone will "know" where to look for the signals intended for it. CDMA's radio channels are approximately six times wider than TDMA and AMPS, giving it 10 to 20 times the capacity of analog AMPS and four to six times the capacity of TDMA.

Some 30 million subscribers (10 million in North America, 20 million in Asia/Pacific) are already on CDMA systems. It is currently used in 27 countries, and CDMA networks are being built in 35 more.

In the United States, TDMA cellular technologies are known by a bewildering lineup of names: Personal Communications Services or PCS; Digital AMPS; North American TDMA; IS-54; or IS-136. Up to eight calls can be carried on the same frequency, but after that the signal becomes degraded. TDMA is popular in the U.S., where most cellular customers still have analog units, because it can coexist with analog channels on the same network.

North American cellular providers with a TDMA-based network, such as AT&T and SBC, have opted for a different upgrade, EDGE (Enhanced Data Rates for Global Evolution). EDGE will require relatively minor infrastructure improvements, but has a maximum theoretical data rate of only 384 kbps.





The various competing wireless technologies in the United States, which means that a telephone used by one provider will not function in another's network, has helped keep American cellular users in the analog age.

Battleground America

Barely half of American cellular customers are on digital networks. Roaming is expensive, and changing wireless providers requires getting a new telephone and number. Telephone manufacturers cannot put the same circuitry in models destined for different networks, so each unit is more expensive and less effective than it could be. Digital telephones must also be dual mode, or able to function in an analog network when roaming, because digital coverage is spotty in rural areas.

Unlike European countries, which issued national cellular licenses, the U.S. Federal Communications Commission auctioned off 734 cellular markets in the first round of spectrum auctions and 544 markets in the second. As a result, there are 300 wireless operators in the United States. With no national standard and several competing cellular technologies, each operator could implement whichever technology it thought best. The result is a mixture of technologies, and equipment that often is not compatible with or transferable between systems.

Faster wireless transmission speeds are possible only at wider bandwidths, and the United States has little unused radio spectrum bandwidth compared to Europe and Asia. Great Britain recently auctioned off part of the spectrum (for \$35 billion) that in the United States is occupied by television broadcasts. Until broadcasters convert to digital signals, which have their own problems with compatibility and standards, these frequencies are not available for wireless. U.S. wireless providers currently are limited to 45 MHz of spectrum bandwidth, which is becoming more crowded every day.

Another factor contributing to the U.S. lag in cellular use is the practice of charging subscribers for receiving as well as making calls. In most of the world, the calling party pays. This practice means that U.S. cellular subscribers have an incentive to keep their phones off except when making a call. A study by The Yankee Group showed that more than 30 percent of

Americans never turned their cellular phones on except to make a call, 20 percent never turn their cellular phones on for more than 2 hours at a time, and more than 30 percent of wireless subscribers did not know their own cellular telephone number.

In contrast to North America, Europe will have more cellular phones than fixed landline units by 2004, a level already attained in Hong Kong. The European cellular market will grow from more than 150 million (compared to 103 million in the United States) currently to more than 200 million by the end of 2000 and may exceed 300 million by 2004.

Europeans and Asians tend to use cellular more because their landline telephone networks are more unreliable and expensive (or even nonexistent) compared to the United States. European telephone customers pay for each landline call they make, local as well as long distance, while most Americans receive unlimited local landline calls. That provides no incentive to use mobile phones for local calls.

Unlike Americans, many European mobile phone users have come to rely on their telephones for access to the Internet, using telephones with business card-sized screens to display everything from e-mail to stock prices.

Japanese cellular subscribers also surf the Web with their telephones in increasing numbers. The number of mobile phone users in Japan increased almost 20 percent from 1999 to 2000, for a total of 61 million (48 percent of the population) at the end of August 2000. NTT DoMoCo, the leading Japanese wireless carrier with 33.7 million subscribers, is also the country's top Internet provider, signing up 11.1 million subscribers in only 18 months of operation.

Telephone As Surfboard

Extending the Web to the telephone will probably at first be accomplished through the use of Wireless Application Protocol, or WAP. The pivotal standard of the wireless Internet, WAP is designed to work with any network, 3G or 2G, CDMA or TDMA. It specifies a minimum amount of functionality, but supports additional, more sophisticated layers. Today's cellular networks can deliver only basic Internet information effectively, a capability that will grow steadily if data trans-



Wireless By The Numbers

30 - Percent of U.S. cellular subscribers don't know their own mobile phone number.	wireless subscriber in 1999.	10 million - Wireless customers added in the U.S. from 1983 to 1992.
40 - Percent of all cellular phones are sold to customers upgrading their existing mobile phones.	1997 - Year when worldwide cellular phone sales exceeded computer sales, 100 million to 80 million.	61 million - Japanese own cellular telephones.
\$41.24 - Average monthly local cellular bill in 1999.	7,147 - Workers directly employed by wireless service providers in 1987.	90 million - Wireless customers added in the U.S. from 1993 to 2000.
\$97.83 - Average monthly local cellular bill in 1987.	155,817 - Workers directly employed by wireless service providers in 1999.	300 million - European wireless customers by 2004?
247 - Minutes of airtime used per month by average U.S.	90,000 - Wireless phones sold every day around the world.	1.26 billion - Wireless customers around the world by 2005?

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mission rates soar as expected.

But don't expect to see a full-color, full-size Web page pop up on the screen of your WAP-enabled mobile phone's screen. Web-based services transported via wireless to mobile units will look different from those delivered to desktop computers. WAP incorporates Wireless Markup Language, a simplified version of the familiar HTML system developed specifically for producing content for display on mobile units.

So far, the market results of WAP are varied. Customers say it takes too long to load a page, and sending e-mail is difficult on a unit without a keyboard. In Germany, cellular providers have sold or given away millions of WAP-enabled phones, but the average German WAP customer uses the service only 1 minute a day. Sweden has the most WAP phones and customers than any other country in the world, but bankers there say customers are reluctant to use their phones to monitor bank accounts. Italian wireless

provider Omnitel began offering WAP services to its customers in late 1999. Customers pay 195 lire (about 10 cents) a minute to surf the Internet and correspond via e-mail. Italians may be more likely to see their telephone as an Internet surfboard than Northern Europeans or Americans: For every Internet PC user in Italy there are five mobile telephone customers. The problem with current WAP systems is that current cellular networks cannot deliver the amount of information needed to make up an Internet page, and even if they could, today's telephones could not display the pages. But this will change, as new phones come onto the market, as Web designers build pages for mobile users, and as 3G networks replace the existing infrastructure.

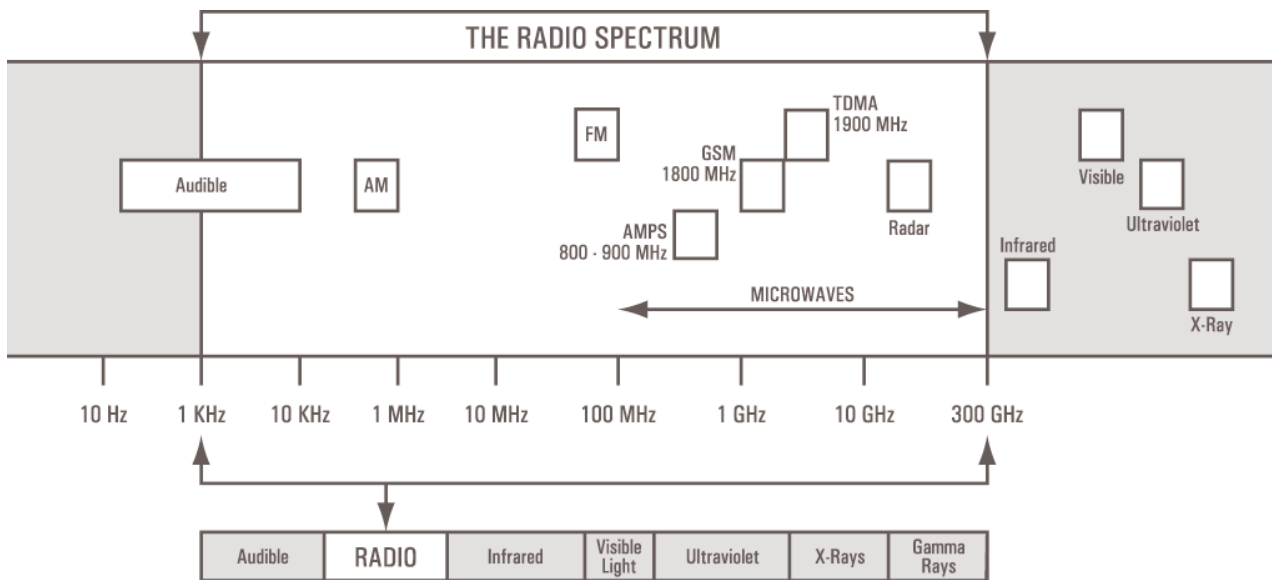
Major telephone equipment makers--such as Ericsson, Nokia and Motorola--have adopted WAP. Cell phone makers will begin producing WAP-compatible handsets (known as "pre-WAP devices") by the end of 2000. By mid-2001, all digital cellular handsets shipped in the world will be WAP-compatible.

Within two years, manufacturers are expected to produce at least 100 million browser-enabled handsets, and more than 500 million units within five years. Content availability is also improving. A survey by Pinpoint.com in April 2000 found 150,000 telephone-friendly Web pages, but 2.4 million WAP-compatible sites only three months later.

If the future is wireless Internet, the road to the future might not be WAP. WAP is the current standard, but not the ultimate one. It was designed to



FREQUENCY DIVISIONS OF THE RADIO SPECTRUM



The radio spectrum, which is only a small part of the electromagnetic spectrum that includes everything from visible light to X-rays, has been subdivided and distributed among scores of users and applications. The radio spectrum extends from 3 kHz (3,000 cycles per second) to 300 GHz (300 billion cycles per second).

THE BREAKDOWN:

100 kHz to 300 kHz: Maritime navigational signals

35 kHz to 1.6 MHz: AM radio

54 MHz to 72 MHz: TV channels 2, 3 and 4

76 MHz to 88 MHz: TV channels 5 and 6

87.5 MHz to 108 MHz: FM radio

108 MHz to 118 MHz: Global Positioning System and other range-finding transmissions.

118 MHz to 136 MHz: Air traffic control

174 MHz to 216 MHz: TV channels 7 to 13

225 MHz to 400 MHz: Military applications (also used by garage-door openers)

470 MHz to 806 MHz: TV channels 14 to 69

800 MHz to 900 MHz: SMR (Specialized Mobile Radio)

824 MHz to 893 MHz: AMPS (Advanced Mobile Phone Service), D-AMPS (Digital AMPS), CDPD (Cellular Digital Packet Data)

890 MHz to 960 MHz: GSM (Global System for Mobile Communications)

900 MHz: Digital cordless phones.

1800 MHz to 1900 MHz: PCS (Personal Communications Service), CDPD

2305 MHz to 2320 MHz/2345 MHz to 2360 MHz: Frequencies designated but not yet awarded by FCC for wireless communications applications.

2450 MHz: Microwave ovens.

5030 MHz to 5090 MHz: Aircraft landing radar

work with the low-bandwidth cellular systems of the 1990s and telephones with screens capable of only four lines of text. It will be obsolete in a high-speed world, but specifications can be revised to extend WAP's useful life.

Innovative engineers and specialists around the world are working on better ways to transmit data to users in the field. The pro-WAP forces say the telephone's small screen and weak processing power makes something like WAP a necessity. The anti-WAP contingent argues that the incredible data transfer speeds possible with 3G cellular networks and packet-switching technology will eliminate those hurdles.

New telephones that can operate on an Internet Protocol network (IP is a format that allows data packets to be switched over the Internet) will replace less-capable units within a few years. Data

transmission over IP networks is expected to go from 613 million minutes this year to more than 972 billion minutes in 2004 .

Tool Of The Future

Tomorrow's wireless handsets will be so sophisticated that the term "telephone" may not be appropriate. The telecommunications industry is evolving beyond a focus on the historical accident of copper wire landlines to realize the potential and promise of wireless telephony.

Functions of wireless units will be extended beyond voice transmission to encompass the sending and receiving of huge amounts of information. They will combine the function of the telephone with the capability of the computer to produce a versatile tool with the best assets of both.

Carter & Burgess Helps Clients Make The Right Connection

The Telecommunications Facilities Group of Carter & Burgess specializes in providing answers to telecommunications questions and needs through innovative engineering and project consistency. With project experience ranging from cell site design to major switching centers to carrier hotels and Internet data centers, we understand how to support planned projects as well as expedited projects driven by market demand.

Carter & Burgess clients can call upon the resources and expertise of hundreds of skilled engineers, architects, planners, and project management specialists who emphasize quick response to telecommunications clients' special needs. Client-focused teams, consisting of specialists with various disciplines, are formed for

the duration to coordinate the entire project, from advanced planning through design, construction administration and facilities management. From start to finish, these professionals emphasize quality control, timeliness and cost efficiency.

Consistently listed at the top of a variety of industry rankings of A/E/CM firms, Carter & Burgess is a full-service firm offering consulting services to the telecommunications, transportation, land development, public works, retail and building industries. The firm has been in continuous professional practice for 60 years. Over the past 10 years the firm has experienced rapid, sustained growth, and has expanded geographically to office locations in every region of the country.

Dialing For Data: Demand For High-Speed Transmission Spurs Growth Of Wireless

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Learning From Phase I Cities: The Dallas Stormwater Utility

Faced with NPDES Phase II deadlines, smaller communities look for ways to pay for their programs.

By Steve Veal, Allen Mullins

As the March 2003 deadline looms for small municipalities to apply for the United States Environmental Protection Agency's Phase II National Pollutant Discharge Elimination System (NPDES) permits, many lessons can be learned from larger cities that have already had to comply with Phase I of this program. Most notably, Phase II communities can see how Phase I cities went about creating a stormwater utility to fund the permitting objectives: protect citizens from stormwater runoff pollutants. Perhaps the biggest concern for communities is the cost of the program. EPA estimates that annual permit costs for small, regulated municipalities will average about \$10 per household. For a city with a population of 30,000, five-year permit costs could approach \$100,000 per year, according to the agency's studies.

However, EPA sometimes has initially underestimated permit compliance costs. For example, the agency severely underestimated both the permit application and implementation costs to Phase I cities. The Phase II estimates appear more realistic but still low.

No city leader wants to burden residents with unreasonably high utility bills or property taxes to help cover the costs. On the other hand, these leaders don't want their residents' health to be adversely affected because of high levels of pollution in local waters. Thankfully, experience shows that it is possible to manage costs *and* maintain safe environments. The key to success is establishing a good stormwater utility.

The dual purpose, from the municipalities' perspective, is to establish a utility that meets both the objectives of the EPA guidelines and the development models of each city. For newer communities, expansion of a storm sewer network to keep up with new growth is a key goal. For older communities, the revenues from utilities offer an opportunity to upgrade and refurbish existing stormwater systems. Regardless, the utility must pay for itself as quickly as possible and be viewed by both the residential and corporate citizens it serves as a worthy benefit for which they are willing to pay.

Fortunately, the Phase I program of the early 1990s provides Phase II communities with numerous

models that can serve as pro forma lessons in the development of their utilities. Though Phase I cities had a broader set of requirements, including more onerous industrial oversight requirements, both phases must address illicit connections and illegal dumping, plans for stormwater runoff from construction sites (and the impact on the stormwater environment once those projects are completed), cleaning up stormwater runoff from their own municipal facilities (service centers, fire stations), public education programs, and ways to involve the public as the programs are being developed.

One of these Phase I model cities to learn from is Dallas, TX. With a population topping 1 million, Dallas has many big city needs, including social obligations, for which it must pay. The city was facing a budget challenge at the time the NPDES requirements were enacted, and the stormwater utility process was seen as a way to identify and establish a new funding source that could pay for traditional floodplain and drainage costs rather than using money from the general fund.

Dallas's program, considered somewhat visionary at the time, serves as an example of how to properly set up and manage a stormwater utility. Though Carter & Burgess continues to work with numerous communities in setting up their utilities, the "Dallas Model" helped establish a baseline formula for success. It can be broken down into five primary categories, which essentially incorporate the successful execution of many NPDES requirements.

- Identify the costs
- Develop a management organization
- Survey and analyze database assets
- Establish an equitable rate structure
- Educate the public

Identify the Costs

Dallas's total stormwater costs are \$25 million–\$26 million annually, with about half of the money considered a traditional floodplain and drainage expense, and the rest earmarked for NPDES. The city's utility generates about \$21 million in annual revenue, with the balance of its budget coming from the general fund. Therefore, not counting the NPDES expenditure, the utility relieves \$12 million–\$13 million from the general fund that previously would have paid for floodplain and drainage.

"The unfunded mandate portion of the NPDES requirement is part of the equation," according to Frances Verhalen, program manager for the City of Dallas Stormwater Utility. "But in addition to being responsible for floodplain and drainage issues, the city also has to deal with quality issues, which prior to the edict had not been addressed. These can be expensive when EPA requires sampling, inspections, and other activities in order to comply with the permit. The floodplain issues are very straightforward, but quality issues aren't so clear. For example, if there's a hazardous spill, the cost of the cleanup is very minimal if it's contained before it reaches the system. But if it's not, then those cleanup costs can rise significantly."

So in addition to enabling the city to comply with NPDES obligations, the utility becomes a vehicle for reducing the entire cost of managing water quality.

In Dallas, most of the services that contribute to the utility are left intact in their respective city departments but are funded out of the utility budget. In many cases the utility group is a small corps; in other cases it is large. Support services come from other departments within the city.

Identifying all of the costs relative to stormwater and drainage, regardless of the department in which

they're located, is the logical starting point for establishing a stormwater utility. However, many communities don't initially appreciate or recognize what all those costs are. For example, mowing the grass in the drainage channels within a park is a stormwater cost, although many view it as a park maintenance cost. Hazardous material (HAZMAT) management is another example. In the old days, if a gasoline spill occurred on a road, the fire hoses would come out and it would be washed down the sewer. Today it's also a water-quality issue, so a lot of HAZMAT tasks and duties can be considered stormwater utility responsibilities. It's important to properly identify and then segregate all those costs and establish a baseline for each particular service.

Develop a Management Organization

Experience in developing utilities has proven that establishing a "lean and mean" management structure within the utility works best. Dallas's stormwater utility has a monitoring and management group of about 16 employees, reports Lisa Jowell, water-quality engineer for the utility. This group has the responsibility of delegating tasks to other departments yet retains oversight and monitoring duties.

For example, Dallas's parks and recreation department deals with erosion control on municipal property. By sweeping the streets, the street department removes sediments and pollutants that attach themselves to those sediments. It also manages the pump stations and levees that control stormwater flow. Through a joint program with Dallas County, the city's public works department deals with normal hazardous waste cleanup, while the sanitation department manages citizen drop-off locations for paints, pesticides, and household chemicals. The public works department performs design work for water retention ponds and other erosion control projects, and the water department handles billing and collections.

"Since we're primarily a management office, and other departments are charged to perform most of the tasks relating to stormwater issues, we prioritize these tasks and make as many happen as possible with the funds that are available," states Dallas's Verhalen.

Survey and Analyze Database Assets

The revenue collected by any public stormwater utility is based on property ownership, land area, land use, impervious area, or a combination of these elements. The creation of a revenue stream for a utility requires identifying the watershed inventory for management purposes and establishing a property inventory for billing purposes.

One of the more costly requirements for some communities is developing a storm sewer inventory. We've found that some Phase II cities have good maps of their systems, but most don't.

In some cases, utilities have been developed without performing this inventory, primarily for water-quality management, prior to trying to meet NPDES regulations. For example, Stephenville, TX, a Phase II community southwest of the Dallas/Fort Worth area, had taken no inventory of its stormwater and watershed features before deciding to create a utility to pay for some required system repairs. Creating the utility included developing an updated drainage master plan to include additional areas of localized flooding and to reevaluate previously determined solutions to alleviate flooding and expand capacity of existing channels.

As with Stephenville, most Phase II communities do not have financial and staff resources as ample as

those of Phase I cities. As a result, they must identify the initial and long-term mission of the utility: to manage stormwater quantity, or to address water quality? Stephenville is taking the quantity approach. Its new stormwater utility revenue stream will be used to develop new drainage systems. Water-quality issues likely will be addressed later.

Fortunately there is enabling legislation for Texas (the Municipal Drainage Act) that sets some guidance and terminology regarding stormwater utilities. Many states do not have that yet. On the financial side, the Texas act establishes the guidance and limitations regarding identifying the customer and also a cost-of-service approach for all utilities. It defines benefited property (since this is a new service) and helps create a basic service unit.

Establish an Equitable Rate Structure

Diligent attention to data quality is a primary concern when setting up a billing system for a utility. Those communities that spend time ensuring that the information they maintain is accurate will find their billing systems come together much more successfully. Stephenville is a good example: It has a new information technology system with harmonious software and updated GIS maps that are cross-referenced easily and compatible with its billing database.

Setting up Dallas's billing system, on the other hand, involved working with data in a proprietary system and from different sources. The databases of the water utility, city tax office, and the Dallas County tax appraisal district were merged to create one master database. Since there were no GIS files at the time, it was a challenge. There were more than 200,000 water and wastewater customer accounts that had to be matched to land-use and land-area data in order to determine the number of equivalent billing units for each parcel. More than 40,000 parcels had to be manually matched. This process included matching the customer account address to the parcel characteristics and sometimes included driving out to inspect the property. It took approximately 90 days to create the initial billing database.

Typically there are two basic approaches to setting up a rate structure. Dallas used the engineering design criteria based on runoff coefficient and the area of each tract of land. These criteria help set an adjusted payment formula by determining runoff ratios for land use and developing multipliers to the land area. The result is the equivalent impact of stormwater quantity and quality for each land parcel. By using the engineering design criteria, less individual tract analysis was necessary and the data appear to be more reflective of each individual tract's contribution to stormwater quantity and quality. It is also easier to explain to the public and relatively simple to execute.

Another methodology, used in San Antonio, TX, involves individual tract analysis, including calculation of impervious areas on each parcel. However, this can result in some perceived inequities when it comes to billing (and explaining the policy), depending on the precise differences in impervious areas in each neighborhood. This method requires substantial direct tract analysis and human effort.

Many Phase I cities started off with fairly low rate structures. Because of their size, they didn't need a high rate structure to generate the funds they needed, and they probably didn't want to attract a lot of opposition to a new utility rate.

In contrast, Phase II communities are being fairly aggressive with their initial utility rates. They need to generate the funds to pay for the utility and they don't have such large general fund budgets as the Phase I cities. And there is a level of acceptance of the utility concept that wasn't present when Phase I

began. Residents, for the most part, understand now that this is a good concept. Their acceptance is often a positive ripple effect from the education programs launched by Phase I cities.

Educate the Public

Education during the development of the utility is paramount to public acceptance. The stormwater utility's customer service staff first needs to understand how to explain the legal, water-quality and -quantity aspects of the utility. This is a normal operational function, so all it really requires is time.

Once citizens see the stormwater utility rate added to their water bill, customer service representatives will begin to receive basic questions about the utility and its purpose. As for handling more advanced questions, the utility management group can follow NPDES education requirements, which suggest ways and means of communicating the need for a stormwater utility, such as getting out and speaking to classes at schools. Stormwater utilities in Dallas and San Antonio have done this very effectively.

"We sell the quality as well as the quantity aspects of the program," maintains Dallas's Verhalen. "And over time, we find that we are getting some quality contacts from people who are noticing pollution in their creeks. They see things now that they might not have seen a few years ago, and they know we're the ones to call in order to get action when it comes to water pollution.

"We've done a lot of community outreach for a long time through our - Don't Dump it, Dallas' program that's very attuned to public involvement," she adds. "The general education of the public over the years about the quality issues of stormwater pollution leads to better citizen understanding of who we are, what we do, and why we're necessary. Most now accept that just because there's a drain in front of them, they can't pour any old thing down it."

Other communities have seen the benefits of a well-conceived public education program. Initial public acceptance of San Antonio's stormwater utility was very high, and in Laredo, TX, an annual expenditure of six figures for radio and television public service announcements is credited for generating greater public awareness of the stormwater-quantity and -quality issues and an acceptance of the utility's rate and cleanup enforcement programs.

In Dallas, the number of citizen pollution complaints has increased due to increased education, but the level of enforcement activity is expected to drop as continued education brings more people into compliance. "The city has been recognized as having one of the most proactive enforcement programs in the region, and many consider it one of the most proactive in the nation," declares Dallas's Jowell. "And that's an example of the sort of help available to these Phase II communities - knowledgeable consultants and Phase I communities like Dallas who can share their experiences."
