

R_x for Aging Infrastructure: Orange County Utilities Renewal and Replacement Program

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Once you reach 40 it is important to receive regular physicals to check for potential problems. Most people who have high blood pressure don't even know it; the only way to find out is to have your blood pressure checked regularly. Likewise, high blood sugar and cholesterol levels often do not produce any symptoms until the diseases become advanced. To ensure the health of its infrastructure, a relatively young and healthy Orange County Utilities is taking proactive measures in preparation for an upcoming wave of renewal and replacement (R/R) needs.

Utility Background

The Utility owns and maintains approximately 1,221 mi of gravity sewer, 563 mi of force main, over 30,000 manholes, and 715 pump stations. The R/R capital improvement program (CIP) was initiated to prepare Orange County for the inevitable wave of needs as infrastructure assets age and deteriorate.

The R/R program is ensuring that systems will be evaluated, pipes will be fixed, pumps will be refurbished or replaced, and effective standards will be put in place to guide future infrastructure assessment, management, and operation. It established an appropriate strategy for the County to make key decisions about which assets to address and when, to apply available funding to system needs in the best and most appropriate manner, and to keep program priorities current and in focus.

The R/R program is expediting projects so that the real work of condition assessment, engineering, and construction of needed improvements occurs in a logical, timely, and cost-effective way.

Today, through the basic prescription of system knowledge, effective planning, and teamwork, the Utility has a clear view of its Capital R/R program needs to address the aging system assets. More importantly, it has an organization to support the program, standards, and procedures to ensure consistency and efficiency, tools to manage data and ensure data quality, and confidence in knowing the conditions of its infrastructure assets and the R/R needs. At the same time, the County is self-performing work more effectively, allowing it to maintain control over quality, manage expenditures, provide stewardship of the public's assets, and provide good careers for the next generation of public servants. This article presents how this path to successfully managing infrastructure health was created and how it will produce benefits well into the future.

Strategic Plan

The first step in establishing the Orange County Utilities Capital R/R Program was to examine, diagnose, and write a prescriptive plan. Current funding, organization, processes, and procedures were assessed, and an overall program strategy was developed. The strategic plan, delivered approximately six months into

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the project, identified preliminary funding needs, potential improvement opportunities, and the framework for follow-up tasks to be addressed in the program.

In the absence of comprehensive condition data, one way to examine potential R/R funding needs is to view the age of assets as compared to expected useful life. The program consultant assembled available data to develop age distribution curves for Orange County Utilities' wastewater infrastructure components.

The age profiles indicated that a number of assets had exceeded or are approaching the end of an assumed useful life. Further, the rate of deterioration typically accelerates toward the end of asset life, potentially increasing operations and maintenance (O&M) costs and increasing the likelihood of failure. Condition assessment is the only way to validate infrastructure asset condition and make the best life-cycle decisions for maintenance and R/R purposes. Based on data provided by Orange County Utilities, operations staff spent significantly more of their time on responsive and corrective work in comparison to preventive maintenance for the gravity system and pump stations. Such data was an indicator of potential R/R backlog in the system.

Orange County Utilities' annual R/R CIP expenditures between the years 2000 and 2008 averaged \$11.7 million. Initial projections developed during the strategic plan indicated that annual spending on R/R could be significantly higher.

Orange County has grown substantially over the past 30 years. In keeping up with that growth, Orange County Utilities has focused significant effort on extension of service and meeting capacity demand. As a result, the existing processes around new project execution are well developed and considered effective. R/R activities often occurred as part of other capital projects and were not ideally coordi-

R/R Program Vision and Expectations

Orange County Utilities' state-of-the art, proactive R/R Program will ensure timely and appropriate investment in system improvements necessary to sustain the reliability of the County's infrastructure assets while minimizing life-cycle costs of ownership. The program is expected to accomplish the following:

- Understand and Manage Risk
- Effectively Target R/R Priorities
- Efficiently Perform R/R Work
- Provide Flexibility to Adjust R/R CIP Project Output for Funding Variability
- Accurately Forecast R/R Needs

nated, validated, and communicated. Since objective criteria for project prioritization were not fully developed or consistently used, project priorities often changed. Scope changes and delays in execution often resulted.

The strategic planning effort determined that R/R processes within Orange County Utilities were in varying stages of development and effectiveness. In general, a systematic approach was not always followed for all R/R activities.

Program Vision, Expectations, and Strategies

To guide the development of the R/R CIP, the program consultant and Orange County Utilities staff developed a vision statement and initial strategic objectives for the initial implementation of the program. In workshops, key questions were framed for four perspectives, also termed a “Balanced Scorecard”: Business Processes, Financial, Learning and Growth, and Customers and Stakeholders:

- ◆ *Business Processes:* What business processes must we excel at?
- ◆ *Financial:* How should we allocate funds and control costs?
- ◆ *Learning and Growth:* How will we continue to enhance knowledge, skills, and abilities for an effective R/R program?
- ◆ *Customers and Stakeholders:* What benefits do we need to provide? How do we create value?

The resulting strategic framework included nine initial strategies for meeting program expectations from these four perspectives. These nine strategies form the foundation and initial focus for establishing an effective R/R program and for evaluating the initial objectives and program activities.

Strategic Plan Recommendations

Months of meetings and evaluation identified a number of potential improvement areas that provided the framework for the program.

Condition Assessment

Condition assessment is a vital part of an R/R program. On a broad, strategic level, knowledge of asset condition allows effort and funds to be allocated to the most appropriate assets and provides confidence that the existing infrastructure is being managed effectively. On a narrower, tactical level, condition assessment is what determines the appropriate scope of work for a particular rehabilitation/replacement project.

Condition assessment was being per-

formed by Orange County Utilities but not on a system-wide basis. More formal procedures for performing the inspection/condition assessment were recommended to promote consistency in a process that involves multiple parties (engineering, operations, construction inspections, and various consultants).

The strategic plan led Orange County Utilities to incorporate criticality-based planning, establish a program of assessing the condition of priority areas, develop processes to expedite the timing from problem identification to remedial action, forecast expected expenditures, and update and manage changing priorities as work gets completed.

Organization

The previous organization within Utilities Engineering supported the capacity growth and service extension projects as a priority, with a focus on projects identified as part of the master plan. To more effectively handle R/R projects identified by Operations and spurred on by development and transportation projects, the Infrastructure Renewal Section was established. Orange County Utilities supplements its existing forces through its R/R program consultant and continuing consultants.

As an outcome of the strategic plan, this group oversees the R/R program project delivery (design and construction), as well as the “planning” necessary to develop priorities, manage decisions regarding necessary work, and maintain the ongoing activities of inspection, condition assessment, priority management, and budget development/refinement.

The organizational structure provides clearly defined responsibilities, functional clarity, and adequate staffing to support the R/R work performed as part of the program and

R/R work done by others, which was an identified improvement opportunity.

Communication /Coordination

R/R work occurs as part of many different projects as well as under the capital budget and operation and maintenance budget. Essential to the success of a program was to develop R/R teams that regularly met and communicated issues, progress, and improvement opportunities. Specific teams were recommended for gravity, force mains, and pump stations. Monthly meetings are the main communication avenue between Engineering and Operations and are where most R/R program-related decisions are made.

Proactive R/R Planning Process

Orange County Utilities desired to improve R/R by developing a program to identify and execute R/R CIP work in a proactive and structured fashion. The goal of a proactive R/R program is to confirm R/R needs based on actual condition in time to implement a cost-effective solution at an appropriate interval before the asset reaches the end of its useful life.

Major changes to the R/R CIP planning processes and R/R CIP workflow strategies included:

- ◆ Perform project validation and scope definition earlier in the planning process.
- ◆ Perform condition assessment at the project identification phase.
- ◆ Standardize program procedures, prioritization criteria, data collection, and management to support decision making.
- ◆ Improve communication of R/R priorities and activities between Engineering and Operations.

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<p style="text-align: center; margin: 0;">Business Processes</p> <ul style="list-style-type: none"> ■ Better establish, manage, communicate, and execute R/R priorities ■ Expedite a just-in-time, proactive R/R Program ■ Effectively respond to fluctuating funding levels 	<p style="text-align: center; margin: 0;">Financial</p> <ul style="list-style-type: none"> ■ Provide a justified R/R budget ■ Improve the CIP budgeting and tracking process ■ Accurately forecast R/R financial needs and establish funding levels to effectively manage risk
<p style="text-align: center; margin: 0;">Learning and Growth</p> <ul style="list-style-type: none"> ■ Engage, educate, and motivate staff in accomplishing R/R strategies 	<p style="text-align: center; margin: 0;">Customers and Stakeholders</p> <ul style="list-style-type: none"> ■ Maintain excellent customer reputation and promote public acceptance of R/R activity ■ Implement R/R spending on a stable, consistent basis

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- ◆ Expedite the timing of rehabilitation/replacement work and plan more effectively.
- ◆ Centralize responsibility for maintenance of the R/R priorities and planning.
- ◆ Create backlog of R/R biddable projects to provide flexibility in CIP budget spending.
- ◆ Improve understanding of priorities and make more effective use of R/R dollars.

In addition, the program consultant and Orange County Utilities staff from multiple divisions were integrated as a cohesive unit, while providing flexibility to adjust staff and annual activities to meet the County's goals and business requirements. The next sections describe the status of programs for each component.

R/R Program Implementation

R/R Planning and Preliminary Engineering activities vary based on asset type because gravity mains, pump stations, and force mains are fundamentally different types of assets with unique deterioration rates, failure causes, and life cycles.

During the evaluation of CIP and R/R processes described previously, opportunities to improve R/R activity and work flow efficiency were identified for each type of asset. Using the program consultant to perform some of the R/R responsibilities accelerated work flow efficiencies. A reorganization and shift in staff responsibilities as the program develops will eventually lead to all program activities being transitioned to Orange County Utilities staff entirely. The following sections describe the implementation of the R/R programs for:

- ◆ Gravity System R/R CIP Implementation
- ◆ Pump Station R/R CIP Implementation
- ◆ Force Main R/R CIP Implementation Strategy

1. Gravity System R/R CIP Implementation

The gravity program was initiated first because it would take the most effort as it is the most complex. Orange County Utilities already had a robust inspection program, in-house Closed Circuit Televising (CCTV) crews, staff dedicated to vendor contract management of CCTV work, quality assurance measures, and experienced condition assessment staff. Because of this experience, Orange County Utilities has stringent inspection requirements and quality control procedures. Specifications already existed with strict execution requirements but were lacking in an extremely important element—consistent data submittals. Robust data standards were not defined, inspection data was in file drawers, and

recommendations were included on individual Excel spreadsheets. To support the new program, more direct interaction was needed between Operations staff reviewing the inspections and Engineering. While miles of the system had been inspected and assessed, data was not widely accessible and was inconsistent. Defined roles and responsibilities and monthly team meetings have greatly improved the interaction and coordination.

Standards and Data Requirements

Initial work focused on establishing the data requirements, beginning with requiring National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP)-compliant databases and naming files in accordance with Orange County Utilities' newly defined standards. This one simple step ensured that the data from any vendor or in-house crew could be validated, loaded into a master database, and disseminated throughout the organization through Orange County Utilities' robust Geographic Information System (GIS).

Master CIP specifications for inspections were updated to include the new submittal requirements, followed by rehabilitation and replacement-related specifications reviews and updates. Work continued to develop a standard bid item schedule that could be used on any gravity R/R project and an associated measurement and payment specification. In addition, computer-aided design (CAD) standards were defined and documented, and drawing templates were established for gravity R/R projects.

Software Tools

With the basics established for the gravity program, a software tool was needed to process, store, and provide access to the data, support the condition assessment process, and help Orange County Utilities manage the R/R program. A search commenced for software solutions that could manage all the inspection data, score pipes based on a set of decision algorithms, provide the mechanism for condition assessment review and tracking of recommendations, and automate creation of contract drawings. A couple of options had potential; however, inevitably each software handled criticality, system inventory, and inspection/R&R planning well (what to inspect and planning level cost projections) but didn't support the detailed process of inspection data management, pipe scoring, condition assessment, and getting R/R work done after a recommendation is made.

Without an off-the-shelf software solution available that met all the County's re-

quirements, the project team developed a custom solution with an Access database on the front end that integrated with the existing GIS. Tables were created in Orange County Utilities' Oracle GIS database to house the PACP inspection data and R/R recommendation information. Scripts were prepared to validate inspection data (from vendors and in-house crews) prior to loading the data into the GIS database. Data validation included checks for valid pipe ID numbers, size, material, lengths, valid defect codes, and data format, to name a few.

As much as possible, Orange County Utilities wanted a system that could automate the R/R recommendations based on the inspection data. The program consultant developed decision trees that would derive specific R/R recommendations based on defect data contained in the database. Orange County Utilities' Engineering and Operations staff were involved in development of the decision logic, basing the outcomes on their experiences and preferences. The decision algorithms were coded and imported into the Access database. Field data is run through the algorithms, and the database generates preliminary recommendations which can then be used to screen pipes for detailed review and final R/R recommendations.

No scoring system is perfect and can be relied upon to make final decisions without some human interaction. However, because the majority of Orange County Utilities' gravity system is small diameter pipe, the decision approach does lend itself more to "automated" decisions than, say, a system comprising large diameter sewers where a multitude of R/R options may exist. For the small diameter system, point repairs, lining, and replacement are the main options.

After data validation, loading, and preliminary scoring, the database provided a single point of access for the condition assessment reviewer to view preliminary recommendations, inspection data, inspection forms, and inspection videos that were warehoused on a dedicated R/R server. The reviewer inputs specific R/R recommendations and provides comments using the database form. The database then sends the recommendations into the GIS database.

In-House Design

Orange County Utilities' collection system, like systems throughout Florida, is almost entirely small diameter gravity mains discharging to a pump station and pumped into a manifold force main system. Cured-in-place lining of small diameter sewers is very cost effective, and the specifications of the liner can

be the same for all liners provided the most conservative conditions are used in the liner design. Since the liner is installed through existing manholes, the only information a contractor needs represented on a contract drawing is a map of the area depicting what pipes are to be lined, information on the manhole access (where it is, diameter, depth), number of laterals, and information as to the ground type.

With data standards, updated specifications, consistent bid items, drawing templates, and GIS, Orange County Utilities was positioned to prepare the lining contract drawings in-house. By managing inspections, performing condition assessment, and using standard specifications, drawing templates, and bid schedules, Orange County Utilities has greatly reduced the magnitude of consultant R/R design contracts as well as expedited the delivery of the projects.

Results

To date, over 250 miles of gravity inspection data has been loaded into the R/R database and 150 miles of pipelines have been assessed. Approximately 30 percent of the priority-vitrified clay pipe has been recommended for lining, and Orange County Utilities is preparing R/R lining packages in-house while utilizing consultants to provide design services for the replacement of gravity mains with defects that cannot be lined and water mains that have inadequate capacity for fire flow, bidding, and construction administration services.

The program is expected to address the priority vitrified clay systems over the next five to seven years. Prior to the R/R program, much of the pipe now recommended for lining would have been recommended for replacement by consultants. This shift means that much of that design work will be done in-house, and Orange County Utilities will realize tens of millions of dollars in construction cost savings.

2. Pump Station R/R CIP Implementation

Orange County Utilities uses life-cycle projections of approximately 15 years for large master pump stations and 25 years for duplex and triplex stations. Initial age data reviewed during the strategic plan indicated that 165 pump stations were already at or beyond 25 years, creating an immediate potential backlog. However, many of those stations that were conceivably past their useful life were not the stations giving Operations staff problems.

Pump station rehabilitation prior to the program was driven mainly by Operations staff selecting problem pump stations. Engineering would initiate a project to essentially replace the pump station, a process that was

time consuming, and often led Operations to address the failing component(s) prior to the project design being completed. No priority list of pump stations had been developed that was based on actual conditions. It was obvious that the program needed to shift to condition-based prioritization of pump stations to determine R/R needs.

Pump Station Inspections

To determine the R/R needs for pump stations and prioritize the stations, a coordinated, standardized inspection, and condition

assessment program was initiated. All 650 duplex and triplex stations were inspected and assessed based on five functional areas: structural, electrical, mechanical, site, and health and safety. During the inspection, individual components within each functional area were rated by a field engineer and pump station operator. The data was entered into a pump station database, and photographs were copied onto the Orange County Utilities R/R server.

After the inspections, an Orange County Utilities engineer performed an assessment on

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each station. The assessment included a rating for each functional area and specific recommendations for each area. Based on the functional area ratings, an overall pump station priority (1 low – 4 high) was assigned. After completing the assessment, the engineer met with the Operations staff to review the results, get final input related to the condition or operation of the pump stations and the recommendations, and finalize pump station priorities.

Thus, defined priorities based on actual conditions are determined jointly between Engineering and Operations. Once established, the priorities define which pump stations are packaged into CIP pump station R/R projects and which would have work orders created to be addressed by Operations repair crews. This approach establishes a clear CIP Pump Station R/R Program and also provides Operations in-house repair crews with clear direction as to where to focus their time and efforts. In addition to specific recommendations for R/R, the assessment process also identified real estate needs for all the pump stations.

Real Estate

Historically, many of the most problematic pump stations were ones where real estate acquisition was needed for either a site expansion or relocation. In the past, real estate acquisition was a long, involved process and a low priority. Over the years, those pump stations that had real estate needs continued to deteriorate without being addressed.

Orange County Utilities has committed a real estate “point person” within Engineering whose responsibility it is to investigate real estate options; initiate the process; coordinate the surveys, appraisals, approvals, and property owner communications; and act as a liaison with Real Estate Management. If the condition assessment of a pump station identifies real estate needs, studies are conducted by Engineering to determine if the station could potentially be removed from service and what other options exist. If options existed, a capacity evaluation of the station where flows were to be routed was performed by Orange County Utilities modeling staff to determine if upgrades were necessary at the other station. If eliminating the station is not an option, the real estate team is engaged to begin searching for available properties that met the criteria established by Engineering. Having a real estate point person ensures that progress does not stop on real estate acquisition, while allowing the Engineering project managers to stay focused on the other stations ready for R/R.

In-House Design

Orange County Utilities’ duplex pump stations are essentially very similar and design standards exist for new stations. Under the R/R Program, specifications have been updated, bid items standardized, and standard drawing templates created to streamline the design process. Engineering has had an in-house design team for pump station R/R, but with a formal program in place, Engineering is now positioned for increased productivity in addressing stations in need of R/R.

It is now the responsibility of the in-house team to evaluate pump station condition, evaluate elimination and alternatives, evaluate capacity, determine real estate needs and acquire real estate, and perform design in-house. Design support, bidding, and construction administration continues to be provided by consultants. The pump station program currently has a goal to address 25 priority pump stations each year, to prolong the life of stations in reasonably good condition, and to address the stations that will inevitably deteriorate from a current lower priority to a higher priority in the next inspection cycle.

Pump Station Program Results

The results of the pump station inspections and condition assessments are as follows:

- ◆ 180 pump stations need full rehabilitation
- ◆ 79 pump stations need relocations
- ◆ 32 pump stations may require property acquisition
- ◆ 240 pump stations need minor R/R to be performed by Operations repair crews
- ◆ Real estate needs are defined, and the acquisition of real estate for each pump station will be completed before final design.

The Pump Station R/R Program will potentially comprise a large percentage of the annual R/R expenditures, possibly in the tens of millions per year for the foreseeable future. Basing the R/R decisions on actual conditions will focus efforts on the areas of greatest need, while optimizing the life cycle of existing stations.

3. Force Main R/R CIP Implementation Strategy

The goals of the Force Main R/R Program are to address force main pipes with known problems, develop analysis support tools to assist in determining the appropriate extent of replacement of problem pipes, and to develop a longer range plan for proactively identifying and addressing force main replacement needs.

Fortunately, the reality of the current situation for Orange County Utilities is that there have not been too many force main failures that have resulted in sanitary sewer overflows. However, that is no indication that the

status quo will continue. The challenge is how to move toward a proactive force main program. The following sections describe the current state of the program, which is still in development.

Initial Priorities – Known Problems

Under the R/R Program, the initial priorities were determined to be the pipes that have already had breaks, excluding those caused by third parties. Maintenance records were reviewed and a series of meetings with Operations were held to document all the known problems in the system. These problem pipes were packaged into projects where preliminary engineering would be performed to determine the need for and extent of replacement. Those projects are currently underway or planned. The engineering evaluation will include a desktop analysis to determine potential problem areas based on material, operating conditions, surrounding utilities, and previous breaks. Once identified, an inspection plan will be developed, and the cost of inspection and expected effectiveness of the inspection will be compared to replacement costs. If inspection is cost effective and can be done with minimal risk, inspection and condition assessment will proceed. If not, a determination of extent of replacement will be made based on the potential problem areas and critical locations.

Force Main System Delineation

The force main system comprises over 6,200 individual pipe segments totaling nearly 600 miles of pipe. Force mains originate at pump stations and extend to discharge points into the gravity system or tie into larger force main manifold systems. To assist in tracking force main projects, as well as provide an opportunity to evaluate force main “systems” during preliminary engineering, the force main system has been divided into 49 “Force Main Areas.” The Force Main Areas are associated with larger re-pump stations and the three regional Orange County Utilities water reclamation facilities.

Force Main Categorization

Force main segments were initially categorized using information within the GIS database. The force main segments in each Force Main Area were initially grouped into one of three categories:

- ◆ Run-to-Fail
 - ◆ Proactive Replacement
 - ◆ Desktop Evaluation - Inspection Plan
- Initial criteria categorized approximately 1/3 of the system as Run-to-Fail and 2/3 as Desktop Evaluation/Inspection Plan. Very few seg-

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ments fell into Proactive Replacement as those were based on the policy of replacing asbestos cement pipe. The list of pipes categorized for Desktop Evaluation is being further honed based on more refined criticality criteria.

Force Main Desktop Evaluation

The force main segments slated for a Desktop Evaluation are being considered for inclusion in a Force Main Inspection Plan that will be developed for each Force Main Area.

Due to the cost and limits of effectiveness of the current inspection technologies, Orange County Utilities does not have the desire or resources to conduct inspections on the entire system. Inspections will be limited to those force main segments that will provide meaningful data in a cost-effective manner.

In addition to determining which force main segments should be inspected, the inspection plan will outline recommended inspection technologies that will be utilized for each type and size of force main to be inspected, if any. In general, each Force Main Inspection Plan will include the following items:

- ◆ List of Force Main Segments to Be Inspected, Including Size and Material
- ◆ Planned Method of Inspection (Technology)
- ◆ Identification of Access Points, if Needed
- ◆ Method of Operational Control (Re-routing, Bypassing, or Tankers)
- ◆ Estimated Inspection Costs

It is important to note that the inspection plan is not intended to require inspections of force mains but rather identify the force main segments appropriate for inspection and outline the methods to be utilized. By creating such inspection plans, Orange County Utilities will have the capability to implement force main inspection programs of varying magnitudes, ranging from as-needed inspections of particular force main segments to a system-wide force main inspection program.

Force Main Area Evaluation Projects

The R/R Program evaluates Force Main Areas on a systematic level. The scope of work for the area evaluations includes a risk evaluation, identification of potential force main elimination and re-routing options, and a capacity and flow analysis. Planned road projects that could impact force mains will be identified. Desktop Evaluations will result in identification of potential problem areas and determining if inspection plans should be developed. If pipes are categorized for potential inspection, a Force Main Inspection Plan will be developed for affected pipes, including cost estimates.

The result of the Force Main Area evaluation will be a detailed categorization of all force mains within the force main manifold area, a list of potential capacity/operational-related improvement projects, re-routing and force main elimination opportunities, a summary of recommended inspections and inspection plans, and an updated list of Proactive Replacement force mains to be considered for inclusion in upcoming preliminary design/design projects. As new force main projects are identified through Force Main Area evaluations, those projects will be added to the priority list.

Force Main Inspection Projects

The Force Main Area evaluations will establish the scope for inspection projects. Force main inspection is very specialized and includes many different technologies. The detailed inspection plans developed during preliminary engineering or Force Main Area evaluation will determine the appropriate technologies and all ancillary work needed to perform the inspections. Based on the results of force main inspections, additional force main projects will be identified and prioritized.

Force Main Project Prioritization

Force main projects will be prioritized twice: once as they are put on the Force Main Preliminary Design Priority List and once again as the project transitions to the Force Main Final Design/Construction Project List. As system needs and available resources will change over time, the initial prioritization performed before Preliminary Design will not necessarily carry through to the Final Design/Construction List priorities. In addition, the method of prioritization is different between the two lists.

The initial priorities are known problem force mains. Additional projects will be identified through ongoing Force Main Team meeting discussions, Force Main Area evaluations, and an eventual Force Main Inspection Program. Priorities for these projects will be assigned based on results and ongoing tracking of O&M work orders related to force mains.

The Force Main Preliminary Design Priority List will be prioritized at the Force Main Area level instead of by individual projects. Historically, force main projects have only included force main segments. However, in order to introduce proactive activities into the force main R/R Program, a Force Main Area system evaluation should be included with any new force main preliminary designs. This approach allows the R/R Program to address imminent problems while also including

proactive care for the system.

Force Main Program Results

The initial strategy for force main R/R has been established and is being refined. Initial priority projects are underway to perform detailed evaluation of the known problem force mains so that the extent of replacement can be determined. Orange County Utilities is also putting into place more defined forensic evaluation procedures, in particular requirements for capturing data related to breaks and pipe conditions any time a pipe is accessed or tapped.

Better projections of needed force main expenditures will be made as the preliminary engineering of known problems are completed, area evaluations are performed, and an inspection program is better defined.

Conclusion

Orange County Utilities' prescription for aging infrastructure is a proactive approach that combines strategic planning to identify improvement opportunities, organizational restructuring to accommodate R/R activities more efficiently, and robust implementation that adapts the R/R approach and resources to the specific needs of each type of infrastructure managed by the utility.

As a result of the program, it is expected that Orange County Utilities' design costs will be reduced by as much as 30% from pre-program days due to in-house design of lining drawings. More importantly, the program will result in tens of millions of dollars in construction cost savings due to more lining of gravity pipes in lieu of replacement and more appropriate rehabilitation of pump stations based on the actual condition assessments. In addition to the direct cost savings, Orange County Utilities has peace of mind about the conditions of the public's important infrastructure assets and confidence that well-defined plans are in place to address the R/R needs and sustain the system's health in the years to come. Additional benefits to Orange County as a result of the R/R Program include:

- ◆ Streamlined processes and defined roles and responsibilities
- ◆ An organization that understands the importance of R/R and is committed to the program
- ◆ Standards (proposal templates, bid item schedules, master specifications, drawing details, etc.) to streamline design and contract procurement
- ◆ Robust tools to support planning, data management, condition assessment, and design