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THE DIGITAL WAVE

STORMWATER MANAGEMENT'S DATA-CENTRIC FUTURE

Dynamic approaches to stormwater management will be key in sustaining the future of our cities. Climate change, pollution, rapid growth, and aging infrastructure threaten drainage systems already at capacity. All the while, increasingly frequent and intense storms heighten the risk of flooding across the country.

An aggressive, systematic approach to innovating stormwater management—one that embraces real-time digital solutions and protects valuable water resources—can increase return on investment and align stormwater programs with community development needs.

The City of Pittsburgh is proof that digital enablement can elevate stormwater management's revitalization potential. Their City-Wide Green First Plan is starting a process to reinvigorate neighborhoods and spur economic growth through an integrated watershed network that improves water quality and reduces sewer overflows.

Many stormwater management programs have access to the same type of data the City-Wide Green First Plan uses. But a reluctance to adopt new digital strategies is holding them back from getting the most out of their data.

Infusing stormwater data with a digital overhaul to your stormwater system can facilitate proactive maintenance and improve budget planning. The changes might take work, but this paper explains why the renovation will be worth the effort.

ENGAGING STAKEHOLDERS WITH DIGITAL ENABLEMENT

Demonstrating the value of stormwater management to elected officials and communities-at-large can be difficult. Explaining regulatory stormwater compliance requirements in terms of volume or pollutant load reductions is complex. But focusing on the benefits that go beyond compliance (e.g. creating healthier environments and revitalizing neighborhoods) could enhance future communication efforts.

It starts by emphasizing digital enablement in your program. How you collect, manage, and visualize your data matters more than ever. Turning analytics into engaging, tangible solutions could be the difference between approval and rejection.

Digital Green Infrastructure (GI) screening tools such as Arcadis' GI Screening and Prioritization Tool can help key stakeholders realize the ways stormwater programs reduce pollution, solve flooding problems, support a strong economy, and more. Ours evaluates, prioritizes, and recommends the best location(s) for GI implementation (or, if needed, a combination of green and gray solutions) in developed areas.

The upside of well-planned GI can't be overstated. Improving water quality and reducing flood risk is just the start. GI can reduce infrastructure costs, introduce green jobs,[1] and increase property values by improving community livability (better aesthetics, more community cohesion, less noise pollution, etc.)[2]

REAL-WORLD APPLICATIONS

PITTSBURGH CITY-WIDE GREEN FIRST PLAN

Deficient stormwater management plagued Pittsburgh residents with constant combined sewer overflows (CSO). Consistent basement flooding in certain neighborhoods hurt property values and created a recurring financial burden for homeowners.

The Pittsburgh Water and Sewer Authority (PWSA) wanted to develop sustainable solutions for six of the largest CSO contributing sewersheds and develop an urban planning strategy based on comprehensive stormwater management. They selected Arcadis to create a stormwater master plan for three of the sewersheds.

The City-Wide Green Infrastructure Analysis—an in-depth assessment of the PWSA service area through a social and economic lens—supported the PWSA's efforts to engage and educate stakeholders and get buy-in from impacted communities.

The PWSA leveraged the results in developing its Green First Plan, a city-wide Green Infrastructure assessment and plan.

Arcadis followed up planning efforts with the implementation of two sites (the Garfield GI Project and the Polish Hill GI Project) as demonstration design projects. This included site surveys and base mapping development, geotechnical evaluations, conceptual designs, and all necessary permitting for final designs and bid package completion. Arcadis worked closely with the city to ensure secondary objectives (e.g. installing neighborhood parks, minimizing the loss of street parking) were featured in the plan.

BLUEPRINT COLUMBUS GI DESIGN

As part of its Blueprint Columbus program, Columbus, Ohio, is making significant investments toward reducing stormwater volume and attenuating peak runoff to minimize costly storage requirements and total sewer overflows.

The city uses our GI screening tool to easily identify favorable GI sites with minimal fieldwork. It provides documentable support for design decisions, recognizes potential conflicts prior to the modeling phase, and develops replicable approaches for future projects.

Arcadis also developed a detailed surface modeling approach that models GI units at the block level to better predict their effects on flow reduction and sewer overflow measures. So far, they've cut costs by $12 million compared to original planning estimates ($41 million to $29 million) employing this approach.

The tool uses specific scoring categories for a range of parameters to display preferred GI opportunities. An advanced programming language allows for more consistency and quick recalculations of new or modified data inflows. This cost-efficient evaluation of large data sets saves hours of work typically spent processing digital files manually.

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LOS ANGELES NATURAL INFRASTRUCTURE PROJECT REVIEW

The Nature Conservancy (TNC) wants to enhance biodiversity in Los Angeles by supporting multi-benefit stormwater infrastructure in L.A., particularly in communities that have been historically underserved. To support TNC in this work, Arcadis launched a pro bono initiative that includes a demonstration project along the Los Angeles River.

TNC is utilizing our digital expertise to optimize their plan. Their in-house data scientists and ecologists work with a customized GI Screening and Prioritization Tool to evaluate proposed projects at a watershed level, quantify their benefits, and measure their feasibility. The easy-to-understand outputs enhance TNC's presentations and improve the chances of stakeholder buy-in.

It's all fueled by a comprehensive, data-centric approach. The tool examines geographic information system shapefiles, enhanced watershed management plans, proposed GI projects, and more. Alternative analyses such as aerial imagery, land use, topography, habitat, and many more strengthen project evaluation capabilities.

The project includes developing analytics interfaces that simplify stakeholder communication and decision-making. For TNC, the interface includes an intuitive geospatial display of the entire Los Angeles River watershed, where users can select certain sites for the tool to visually map at different scales.

The customization features allow users to hone in on local environmental and economic issues, as well as view compliance projects through a triple-bottom-line (social, environmental, and financial) lens.

GOING ABOVE AND BEYOND COMPLIANCE

U.S. communities are subject to the Clean Water Act's regulatory requirements, but it can be a challenge to balance compliance needs with budget constraints and competing programs such as schools, police, and others. Identifying the most cost-effective approach to stormwater management can be a struggle.

Cities, counties, and utilities that own the stormwater system must comply with their Municipal Separate Storm Sewer System (MS4) permit. In many instances, the permit requirements drive the stormwater programs. But the tail shouldn't wag the dog; community and program needs should inform the scope of projects. Stormwater should go beyond the MS4 (and other permit or consent decree) requirements to focus on meeting all environmental and economic needs.

For long-term sustainability, stormwater management that goes beyond compliance is vital. Adopting innovative analytics solutions and digital enablement can help programs:

- Create practical design standards.
- Design projects that fuel community growth.
- Reduce compliance costs.
- Simplify asset management and operations and maintenance plans.
- Establish stormwater as a water resource asset that supports surface-water quality management, reuse, irrigation, groundwater recharge, and environmental protection efforts.
- Integrate regulatory requirements into community/utilities activities, maximizing return on investment.

ALIGNING COMPLIANCE WITH BEST MANAGEMENT PRACTICES (BMPS)

The compliance strategy for **Chesterfield County, Virginia,** emphasizes a healthy environment and strong economy. It focuses on sustainability, resiliency, and alignment of watershed needs with permit requirements.

Their Watershed Evaluation Framework—a critical part of the county's MS4 Permit and Chesapeake Bay Total Maximum Daily Load (TMDL) Compliance Action Plan—outlines the tools, data requirements, and procedures for completing watershed evaluations. It establishes the goals of the stormwater management program, namely the estimation of load reductions in nutrients (nitrogen and phosphorus) and Total Suspended Solids needed to meet the Chesapeake Bay TMDL requirements (included in the MS4 permit as a Special Condition).

Using a digital compliance tool from Arcadis, Chesterfield County was able to evaluate compliance scenarios over three permit cycles (15 years). The tool provided stormwater BMPs applicable to the county such as treatment efficiencies, costs, and implementation criteria. Projects and BMPs were ranked according to triple-bottom-line scores.

The county used the tool to prepare cost estimates for applying program enhancements and structural/non-structural BMPs that addressed their regulator and watershed improvement needs. The estimates formed the basis of their Stormwater Capital Improvement Program and the implementation of a dedicated stormwater utility fee.

To examine how the tool evaluated and visualized pollutant loads for the selection of BMPs in county watersheds, see the figure below.

BMP Tool :

1. Calculate Loads (GIS/Permit)
2. Select (Unit) BMPs
3. Estimate Load Reduction
4. Determine Compliance

The figure below illustrates how Arcadis' business analytics application supports data management requirements. This compatible tool connects with a program's existing data sources to simplify data analysis, prepare dashboards, and produce reports.

Future uses of the tool could include:

- Integrating compliance inspections for the stormwater system and BMPs.
- Tracking Stormwater Pollution Prevention Plans at high-priority facilities.
- Tracking compliance with Illicit Discharge Detection and Elimination requirements.
- Developing interactive compliance dashboards.

CHESTERFIELD COUNTY STORMWATER COMPLIANCE
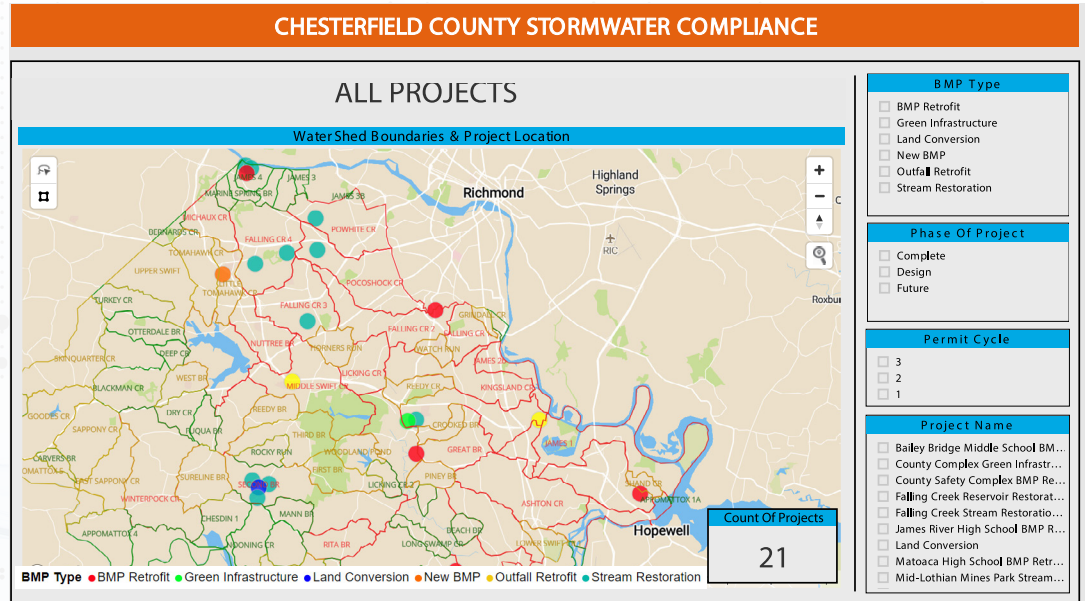
CONCLUSION: TRANSFORM YOUR UTILITIES

Stormwater management is quickly evolving. New approaches are going beyond dealing with pollution and compliance issues to truly reinvigorate cities' environmental and economic plans.

Transformative digital solutions can't be implemented overnight. But cities, counties, and utilities can leverage technology and program integration to:

- Better define a stormwater program's problems and cost-effective solutions.
- Communicate the importance of stormwater management to stakeholders.
- Increase resilience and compliance certainty.
- Foster a culture of innovation around stormwater management.
- Shape a stormwater strategy that capitalizes on digital technology's growing role in stormwater management.

Pittsburgh is just one of many shining examples of how stormwater management can reinvigorate a community. You can create a new paradigm for stormwater management in your community as well. Overcoming the hesitancy surrounding digital enablement is the first step.
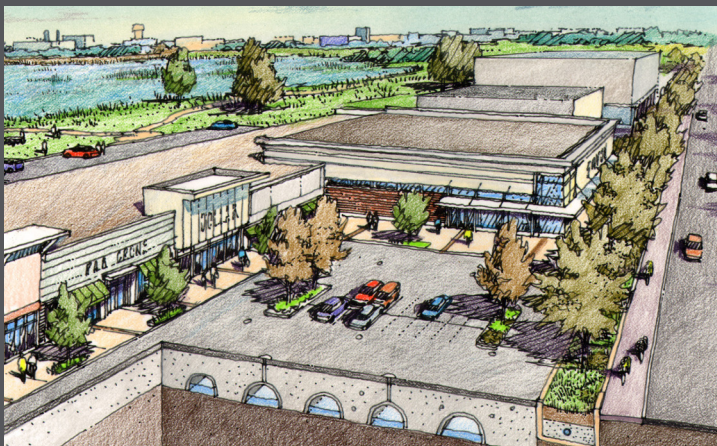
1 Benefits of Green Infrastructure. (2017, March 22). Retrieved September 19, 2018 from https://www.epa.gov/green-infrastructure/benefits-green-infrastructure#communities

2 The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. (2010). Retrieved September 19, 2018 from https://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf

About Arcadis

Arcadis is the leading global design and consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services, we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 27,000 people, active in over 70 countries that generate $3.5 billion in revenues.

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Contact Us

Fernando Pasquel
Stormwater & Watershed
Management Director
email: fernando.pasquel@arcadis.com

Mark Van Auken
Stormwater Practice Lead
email: mark.vanauken@arcadis.com

www.arcadis.com
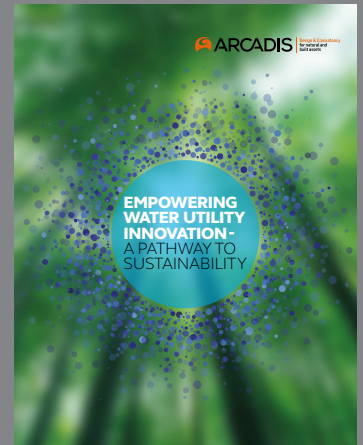
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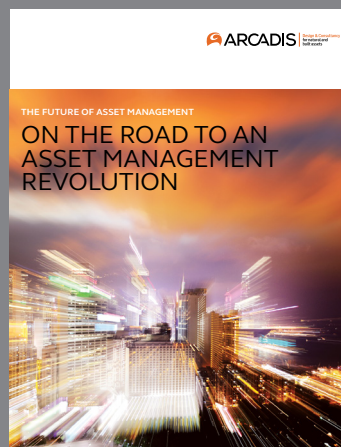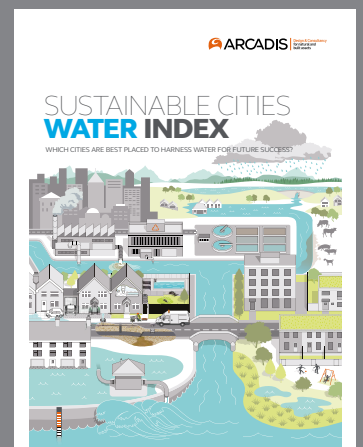www.arcadis.com/DigitalWaterUtility

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