Holism and the evolution of urban watersheds

William James

Founding President, CHI and University Professor Emeritus, U of Guelph

Abstract

The evolution of *holistic sewersheds* is described and global examples given, particularly of related art. Also covered is the "guided" evolution of engineering modelling of sewersheds.

A philosophical leitmotif is that the evolution conforms to JC Smuts' original philosophy of holism. Consequences for sewersheds are *Inevitability, Well-being, Truth, Beauty and Goodness*.

The main point

- is to discuss how public attitudes to sewersheds beneficially change from (in many cases) uninformed ridicule to informed appreciation and social responsibility, and how water engineers may help.

Introduction

Holism is the interdisciplinary idea that a system possesses one or more properties as a whole, *apart* from the sum of the properties of their component parts (of which in sewersheds there are a very great number and variety). The *emergent property* here is a sense of community ownership resulting from broad-spectrum public involvement and leading in the long term to improved sewershed lifetime amenity.

Introduction

Our proposition is that identifiable emergent issues evolve in a guided fashion (i.e. not accidentally, randomly or transcendentally), and that the issues will become part of engineering assumptions and perspectives underlying the design of sewersheds, influencing modelling tools used for their design.

Background

In 1926, Jan Christian Smuts introduced the term ***holism*** in his book *Holism and Evolution*, articulating three fundamental aspects of the concept:

1. Measurable entities, whether physical or psychological, possess an inherent wholeness (well-being, truth, beauty, goodness) that transcends their individual parts.

2. Holism is the guiding force behind evolution, not accidental or transcendent explanations; evolution is a purposeful, creative process, where systems respond to environmental challenges, their parts collaborating for progress.

3. Holism, or *guided evolution*, is evidently inevitable.

Precepts

1. Civil Life begins and ends with separation of contaminated from potable water (and provision of water-resistant pavement and building materials).

2. Inter- and extra-disciplinary involvement improves community consciousness of sewersheds, comprehension of healthy drainage system ecology, and improves the health and function of these basic foundations of civil life.

Digression: a historic moment?

Two keywords juxtaposed in this paper, *sewersheds* and *holism*, are relatively common in their distinct cultures, but otherwise uncommon in the other culture. Figures 1 and 2 present Ngram analyses of the relative frequency of each of the words.

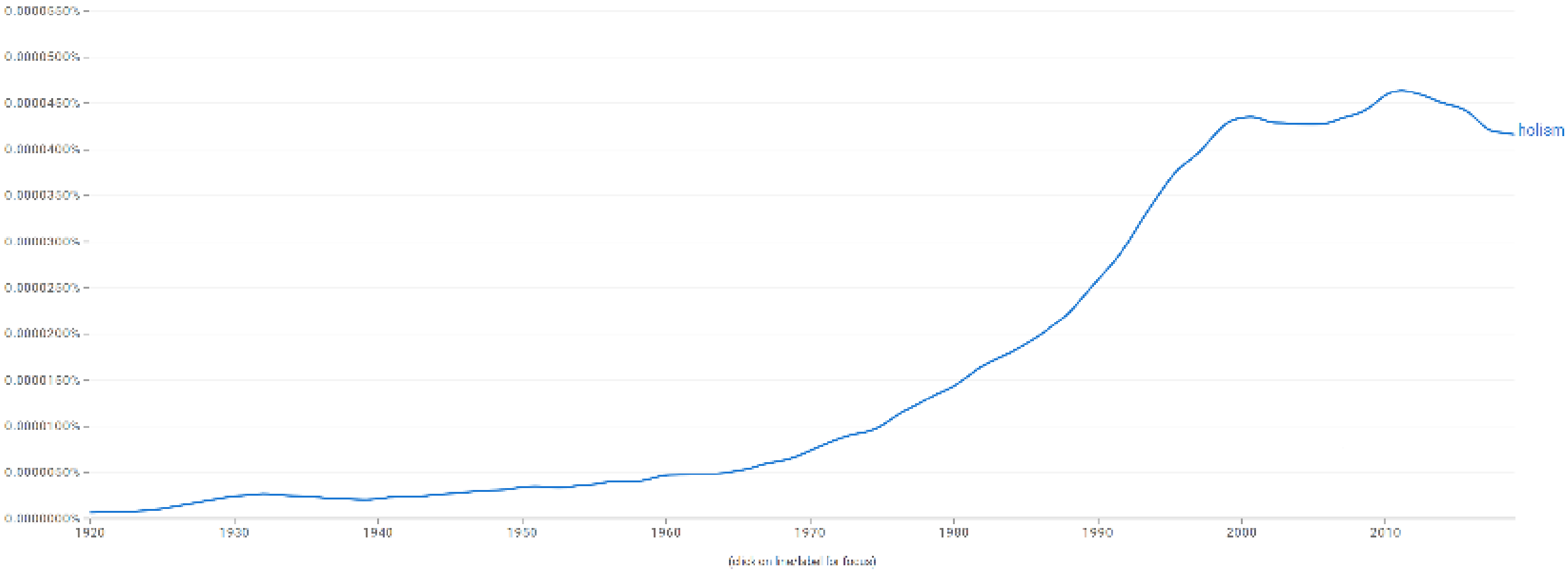

Figure 1 Frequency of appearance in print of the word *holism* in Google's text corpora; the word does not appear before 1920 and reaches a sustained peak ca. 2000.

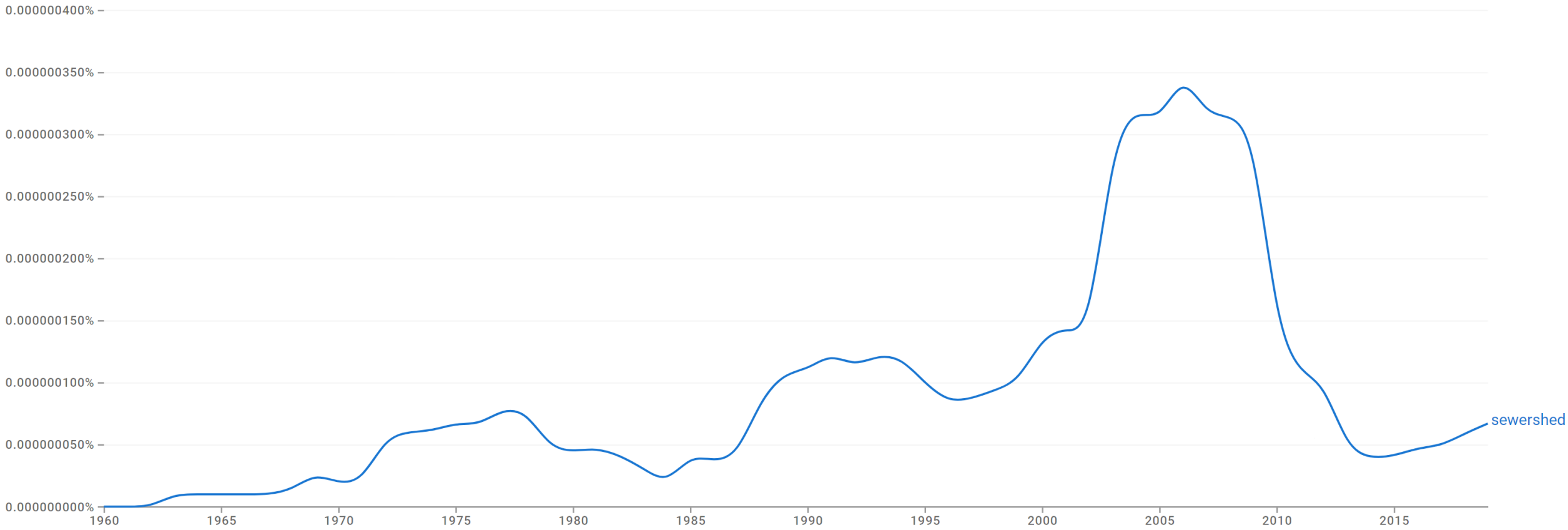

Figure 2 Frequency of appearance of *sewershed* in print; the word is rarely used (three orders of magnitude fewer than *holism*), does not appear before 1960 and peaks relatively sharply ca. 2004-2010.

Unsurprisingly, the expression ***holistic sewersheds*** is unknown in Google's corpora of printed books (there are zero occurrences of the phrase) - *hence this may be claimed to be a historic moment!*

87y-old engineer's bio of 68y of urban drainage design (1956-2024).

Mid 1950s: pencil & paper worksheets, slide-rules, mechanical calculators; rational equation, cumulated peak flows, Manning's equation, steady-state hydraulics.

Late 1960s: electronic pocket calculators and early computers (from 1962); single-event hydrology, steady-state hydraulics.

From early '70s: software and hardware improves; continuous hydrology, unsteady hydraulics.

Currently: continuous 3D models of fluxes of water and pollutants through large urban landscapes run for decades of simulated time on personal computers.

Current practice: Newtonism trending to Darwinism

Curiously, few such models yet(?) include non-STEM (science/technical) concerns and/or values such as aesthetics, well-being and public education. Drainage layouts are mostly predicated on strict calculations of economic, hydraulic and eco-efficiency, and ad hoc allowances are made, e.g. for recreational facilities.

Healthy sewersheds

Two dozen attributes of *healthy* sewersheds are given in Appendix 1 in the full paper; including (a) *collaboration* among stakeholders to ensure effective management, continuous improvement of the sewer system, and public outreach and (b) *education* to promote responsible stormwater and wastewater practices and to build community understanding of the sewer system.

We shall return to both issues.

Extra- & inter-disciplinary approaches

Responding to CP Snow's "breakdown" between the sciences and humanities, activities for ***ten*** contrasting disciplines are tentatively suggested (from the writer's narrow science perspective):

1. Water Resources Engineering:

Demarcate sewersheds in the field starting at the main outfalls and receiving waters. Discriminate between water supplies, stormwater, wastewater and combined sewer collection and disposal, using appropriate iconography and signage. Post in public spaces maps, schematics, charts, line drawings and display physical and live time series data on flux and removal of key pollutants.

Activities listed in this section may be designated Truth.

2. Art:

Improve awareness of main sewersheds by public (street) art. Overwhelming examples of such art exist and regrettably time and space allows only a few photographs to be reproduced below in this essay.

These activities may be subsumed under Beauty.

3. Humanities:

Improve public health and fitness by associating sewersheds with trails for walking, running and biking; waterways (where safe to do so) for swimming, fishing, canoeing and kayaking; and provide varied interesting water parks. Cooperate with the very many associated organisations.

These activities as well as those of the next two groups fall under Well-being.

4. Health Sciences:

Develop so far as is meaningful the analogy between healthy fluid systems in human anatomy and healthy sewersheds; publicise the management of water-borne pathogens and their vectors. Provide water-based amenities for dog and pet parks.

These activities as well as those of the previous and next group fall under Well being.

5. Agriculture and Environmental Science:

Work with (e.g.) Ontario Conservation Authorities who effectively integrate parks, gardens and public spaces that foster recreation alongside bird and wildlife habitats. Highlight vegetation types and their pollinators in the several aquatic zones.

These activities as well as those of the previous two groups fall under Goodness.

6. History:

Conserve historic drainage relics alongside conservation authorities. Show how the drainage system might be restored when populations decline.

7-10. Other disciplines are more problematic...

Letters: Post related poetry publicly (rarely done).

Hospitality and Law: Promote awareness of sewer discharge laws and bylaws.

Music: Perhaps post QR-Codes to web music sites.

Business: Integrate awareness where feasible.

A few of many examples from around the world.

Sherbourne Common (Photograph 1) is a lakefront park designed in 2009 for a vibrant experience, offering open greenspace, a versatile skating rink cum splash pad, pavilion, and an artistic water channel. It is also a stormater treatment facility: stormwater is treated by UV emission and released through sculptures into a 240m channel connecting the park to Lake Ontario. (Wikipedia, Sherbourne Common)

In Stockholm, Strandvägen's two 1994 obelisks (Photo 2) display real-time air quality and treated wastewater contaminant levels. Green lights indicate phosphorus levels, red lights nitrogen levels, in mg/l. They highlight the environmental impact of human activities.

Stenciled messages near storm drains are common (Photo 3) emphasizing that dumping is prohibited because untreated substances pollute local waterways. Often done by volunteer groups, especially children.

In Japan, manhole covers are colorful works of urban art (Photograph 4a), and have become a tourist attraction; enthusiasts travel the country exploring around 12,000 unique designs. Starting in the 1950s, the covers featured simple geometric patterns. In 1985, civil servant Yasutake Kameda introduced intricate, artistic versions to gain support for the modernization of the sewer system, and now the humble, practical manhole covers are a cultural phenomenon in Japan.

In 1935, an alligator emerged from a Harlem manhole and was beaten to death, commemorated every February 9th as "Alligators in the Sewers Day" in Manhattan. In 2001, artist Tom Otterness incorporated this incident into his "Life Underground" sculptures at 8th Avenue and 14th Street subway platforms. The sculpture in photo 4b reminds people of the urban legend of alligators in New York City's old sewage system, and has persisted for over 50 years. (Wikipedia, Sewer alligator).

Seattle features manhole covers created by artists, a project initiated in the 1950s by Seattle's art commissioner, inspired by ornate manhole covers in Florence, Italy. In 1975, a private donation kickstarted the endeavor with 13 covers depicting a relief map of the city. Subsequent donors funded more covers; over 100 covers across the city now feature designs by seven artists – Photograph 4c.

THE CITY OF CALGARY SEWER

Calgary annually replaces ca. 2,000 of more than 200,000 manhole covers. The 500 limited edition Chinook covers in photo 4d were a joint project in 2004 between Calgary Infrastructure and Calgary Public Art. In 2018 the city installed much fancier manhole covers that illustrate the various liquids washing through more than 12,000 kilometres of underground pipes - artists were individually assigned to the three water systems: storm, waste or drinking water.

Two years after 9/11, sculptor David Boyajin decided that Connecticut needed a firefighter tribute that wasn't another somber memorial. So he created "Hero," (Photograph 5a) a multitasking fire hydrant, likewise made of cast iron.

Opposite the firehouse on U.S. Route 7 in Shelburne, Vermont, artist Chris Sharp welded together ten hydrants in the form of a giant toy jack (Photo 5b). Although inspired by "the courage and selflessness" of emergency response personnel, the sculpture is a "playful representation of an overlooked and under-appreciated everyday object."

W 12th Ave & Acoma St

The enhanced detention pond in photo 6 is illustrated on page 10 of the City of Denver publication *Aesthetically Enhanced Detention and Water Quality Ponds*, dated September 2010. The publication describes tools and guidelines for successful implementation of aesthetically-pleasing ponds.

Designed by James Watt & Co ca. 1860s, the magnificent Crossness Pumping Station (Photo 7) raised wastewater 12 m into a reservoir using four beam engines. From there, the effluent was released into the Thames River well beyond London and swept out to sea on the ebb tide. The Romanesque-style architecture features ornamental cast ironwork. (Crossness Engines Trust, undated). Hamilton, Ontario has a similar, less ornate pump station (James and James, 1978).

Toronto is home to several water parks and many splash pads, both indoor and outdoor. Toronto Zoo Splash Island shown in Photograph 8 has several water slides, water sprays, and a tipping bucket. (Toronto Zoo, Splash Island).

“Waterhead" (Photograph 9) is pump discharge outlet artwork in Joure, The Netherlands, featuring graceful steel lines forming a large face rising six meters above a lake. The Corten steel structure stands out against the sky, and from it three water jets discharge water, from which the water then flows through part of the city. (Blocklughart, Waterhead)

The famous Trevi Fountain (Photograph 10a) in Rome, Italy, was designed by Italian architect Nicola Salvi and completed by Giuseppe Pannini in 1762 and several others, standing 26.3 m (86 ft) high and 49.15 m (161.3 ft) wide. (Wikipedia, Trevi Fountain).

Metalmorphosis (Photograph 10b) is a sculpture by David Cerny, comprising 40 steel pieces divided into 7 segments, each capable of independently rotating 360 degrees. Aligned, the segments form a giant metal head. Located at the Whitehall Corporate Center, a 200-acre office park in Charlotte. (Metamorphosis, One of the...)

In 1965, the Kuwaiti government commissioned a modern water-supply system for Kuwait City. Led by chief architect Sune Lindström, 31 water towers were constructed in five groups, known as 'the mushroom towers.' (Photograph 11). (Wikipedia, Kuwait Water Towers)

In 2001, artist Peter Gibson initiated a guerrilla street art campaign in Montreal to advocate for more bike lanes. Gibson adopted the name Roadsworth, emphasizing his role as a "poet of roads" and creatively transforms public asphalt surfaces, Photograph 12, including roads, sidewalks, and parking lots, with paint to convey his message. (Roadsworth, Ground)

In Sidmouth, England, a flood pond was also designed to be an amphitheatre for use when there is no flooding. (Ojeda, 2024)

How public interest improves sewer systems

By implementing similar initiatives, communities promote sustainable practices for environmental and public health and preserve the health of sewersheds - twenty initiatives are listed in the full paper. The following are six ways that public involvement contributes to improved performance...

Early Detection of Issues: *Community Awareness, Reporting Mechanisms*

Education and Outreach: *Best Practices, Maintenance Support*

Community Input in Planning and Design: *Local Knowledge, Acceptance and Compliance*

Emergency Preparedness: *Community Engagement*

Feedback Mechanisms: *User Experience*

Behavioral Changes: *Reduced Overflows*

Social science in sewershed design

Social sciences provide insights into human behavior, cultural values and community dynamics. They are crucial for addressing the diverse needs of communities, helping engineers create more sustainable, inclusive, and culturally sensitive solutions. 21 feasible activities of social science are listed in the full paper.

Conclusion

This paper provides examples of art and education related to sewersheds, and cites *Holism,* indicating that further attributes of beauty, truth, goodness and well-being will inevitably evolve. However these benefits may be delayed if engineering and the humanities are not mutually supportive - if one side fails to see beyond cost-effective hydrologic efficiency, and/or the other fails to see the importance of the efficient underlying function.

Water systems models may need new routines, inputting, for every cultural activity and facility involved, information on location, size, layout, attendance, flow demand, etc., data difficult to know *a priori*.

Fortunately AI programs excel at literature review and at rapidly generating fairly reliable computer code, even in the short time that users respond to model input.

PCSWMM is currently (2023) being enhanced with GPT routines to generate code especially for users' requirements, such as for information on additional facilities in the sewershed under design, planning, and/or management, code which runs in the time taken for normal design input-response.

(Of course PCSWMM evolves according to user desiderata, conforming to Smuts' *guided evolution*).

Finally returning to Smuts' inspiring lines in *Holism and Evolution* (Smuts, 1926. p.344)

"It is the nature of the universe to strive for and slowly, but in ever increasing measure, to attain wholeness, fullness, blessedness. The real defeat for man as for other grades of the universe would be to ease the pain by a cessation of effort, to cease from striving towards the Good.

The holistic nisus which rises like a living fountain from the very depths of the universe is the guarantee that failure does not await us, that the ideals of Well-being, of Truth, Beauty and Goodness are firmly grounded in the nature of things, and will not eventually be endangered or lost. Wholeness, healing, holiness – all expressions and ideas springing from the same root in language as in experience – lie on the rugged upward path of the universe, and are secure of attainment – in part here and now, and eventually more fully and truly."

Let us work to make Smuts' philosophy applicable to sewersheds.

- Thank you.

Thanks:

Discussions: *Bob Dickinson, Rob James*
Presentation: *Kat Finney, Laura-Lee Fletcher*
Sidmouth dry pond: *Ricardo Santaella Ojeda*