



Summer 2004

What's Your Stormwater Paradigm?

– *Andy Reese, AMEC Earth & Environmental, Inc.*
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A little learning is a dangerous thing;
Drink deep, or taste not the Pierian spring:
There shallow draughts intoxicate the brain,
And drinking largely sobers us again.

– *Alexander Pope*

What's a paradigm and how do I shift one? It's what we think is true and right about a certain subject. It's the grid through which we put all information and input about a subject. In fact, its everything we think is true about something. If we thought there were more to know, we would fit it into our paradigm somewhere. Whether our paradigm is, in fact, true and effective is not the point. We believe it is. And we only reluctantly change our

ways and agree to agree with someone else's paradigm. We each have paradigms about most everything... even stormwater. Do you know where you really are in the shifting paradigms of stormwater management? Lets find out.

Early Stormwater Paradigms

The evolution of stormwater practice in the United States is set against the backdrop of social change. Since the 1800's the basic thrust in the United States has shifted from exploration, to cultivation, to industrialization, to urbanization to gentrification. Gentrification is when we need a grande double mocha vanilla decaf latte ("hold the whipped cream") instead of a cup of coffee, and have the money to pay for it. It is when we not only want a safe and efficient neighborhood but a "green" one with walking paths and natural areas.

Paradigm #1 – Run It In Ditches In the beginning the farmers moved to town. And what was good enough for the country was good enough for the city. This led to the first stormwater paradigm: water should run in ditches, just like on the farm.

Everything, and I mean everything, flowed in urban cesspool ditches: slop, wash water, runoff, and chicken bones. This worked for a while and was better than having no drainage system at all.

The drawbacks of this grand solution were soon apparent. Even Benjamin Franklin realized that these ditches were an eyesore (not to mention a "nose sore") and that women trying to cross them risked life and petticoat.



So engineers came up with a solution to this dilemma, and unknowingly stepped into the second paradigm: "lets put it all in pipes."

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Paradigm #2 – Run it in Pipes The urban infrastructure underwent a rapid change around the turn-of-the-century before this last one. Downtown areas became clean and dry. All liquid waste went straight from the amazing flush toilets and sinks to the nearest river or stream. Before separate sewers, combined sewers were just called “sewers.” Today we call this a “combined sewer” system, and you can find planned combined sewers in the center of most older large cities and unplanned ones everywhere.

Sewers solved the mire-in-the-street problem by putting it safely and efficiently in the streams, creeks, estuaries, bays and gulfs where it belonged anyway. I hauled my solid garbage out the front and let my liquid waste go to the stream in back – that, after all, is the highest and best use of streams. But soon plagues convinced cities to shift from well water to surface water, and we soon realized that all this mire-in-the-streams was being ingested by downstream dwellers. So it was determined that we needed treatment plants for sewage, and that treating all that clean stormwater runoff did not make economic sense.

So dutiful engineers came up with a new paradigm, and a solution to this dilemma: run it in stormwater pipes.

Paradigm #3 – Run It In Stormwater Pipes This urban stormwater design paradigm came into vogue in the late 1940's in most parts of the country and reigned until the 1970's or so. *Leave It To Beaver* and curb and gutter were de rigeur.

Technology always comes along to support our rush to engineering excellence. About this time the Rational Method came into prominence, beating out several competitors, as the design method of choice. It was easy to do on a slide rule, and made sense as a mass transfer equation. Intensity-duration-frequency curves became available in many places in the United States in the late 1950's, and everywhere in the early 1960's with the publication of the Weather Bureau's TP40 and Western mountain rainfall maps.

The modern urban drainage infrastructure was born, consisting of an efficient drainage system with catch basins and pipes leading to the nearest stream. And that solved the problem.

Or did it? Anecdotal evidence began to mount. Papers began to appear questioning this paradigm. It soon became apparent to standard engineers that the fruit of an efficient stormwater system is downstream flooding and channel erosion. The literature from the 1970's is replete with papers on the causes of flooding and a groovy new idea to solve flooding forever – on-site detention.

Paradigm #4 – Keep It From Stormwater Pipes The first stormwater detention ordinances appeared in the early 1970's and quickly spread across the country.

Detention ponds are a promise with conditions. Rarely are those conditions adequately met in a local on-site detention program. Those conditions include: comprehensive criteria, consideration of volume as well as peak, downstream assessment, realistic hydrograph routing, detailed plans review, as-built certification, long term maintenance agreements, and strict enforcement.

Lets take one example of the problem of detention design: the Modified Rational Method. The Rational Method is exact for peak flow estimation of a constant flow of water off of a pane of glass, and okay for parking lots and roof tops with some grass and erratic rainfall. Its not a good detention designer. Thousands of ponds were (and are!) designed using the Modified Rational and Bowstring methods. Most are undersized, some grossly. Allowable target flows are set too high because the pre-development C factors, conservative for peak flow, are sometimes non-conservative for setting low-flow target values. Volumes are set too low because the actual runoff hydrograph is not truncated like a simple triangle. Ten-year control does nothing for two-year downstream flooding problems.

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From the Chair

– Jerry Robinson, Chair, IAFSM

Summer is here at last, but it is also the time of year when a major rainfall event can occur and cause devastation in your community. It only takes one large storm to place floodplain and stormwater management issues back into the spotlight. I think that the flooding that occurred in Lake and Cook Counties along the Des Plaines River made many officials in that region realize that while progress had been made, there were still many areas that could have been damaged if the originally predicted flood crests had actually occurred.

The Association has cooperated with the Illinois Department of Natural Resources – Office of Water Resources, Lake County Stormwater Management Commission, and the City of Des Plaines to provide residents of the area with valuable technical assistance in how to prevent future damage to their properties. See the article on page 10 on **open houses**.

I am pleased that planning of **next year's annual conference** is well under way and that we will be returning to Peoria. The annual conference will be held in the same location where we had the 2000 statewide conference, the Holiday Inn City Centre. The hotel has added additional meeting room space since the 2000 conference and will be a great location to return to for the 2005 conference. Mark your calendars to be in Peoria next year, Wednesday and Thursday, February 23 and 24.

We are also soliciting proposals from hotels for the **2006 conference** that will be held in Northeastern Illinois. We have discovered that we need to plan further in advance due to the increased size of the conference. Meeting space that is available is often already booked when we are looking for space. If anyone has suggestions for the location of the 2006 conference, please notify either Sally McConkey (sally@sws.uiuc.edu) or myself (jrobinson@cbbel.com).

I would like to congratulate our **newest Certified Floodplain Managers** who passed the test in Kankakee and at the ASFPM Conference in Biloxi:

- Sally McConkey, Illinois State Water Survey
- Dahlia El-Kaddah, Stanley Consultants, Inc.
- Timothy Kosiek, Hey and Associates, Inc.
- Gary L. Preston, County of Kankakee

And special thanks to Bruce Matthews who set up and proctored the exam in Kankakee. We have updated our website www.illinoisfloods.org to remind people that **CFM exams** are scheduled periodically and will be posted at this site. Any Illinois CFM can proctor the exam, provided all the rules and procedures are followed. If a person is interested in taking the exam and there is a CFM in the area willing to proctor it, an exam can be scheduled with four weeks notice.

On a related note, we have included in this newsletter a **Request for Proposals (RFP)** to update the Home Study Course. The Home Study Course was completed in 2000. Portions of the text have become outdated due to new regulations that have been adopted, so it is time to revise this valuable resource for use by all of our membership. I would encourage any interested parties to respond to this RFP. I would also invite anyone who has noticed discrepancies in the contents of the Home Study Course to notify either myself (jrobinson@cbbel.com) or French Wetmore (FrenchAsoc@aol.com) so we can forward all concerns to whoever is selected to update the Home Study Course.

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Old people along streams were still getting flooded and saying it was not like this in the 1960's. And they were right. So we needed a new and better paradigm to solve this problem... bring in the stormwater Men in Black!

Paradigm #5 – Well Just Don't Cause Flooding The first mainframe hydraulics and hydrology models were converted for PC use in the mid-to late 1970's and became commonly available in the mid 1980's. MITCAT led the way. Every engineer worth his bonus developed a user-friendly HEC-1 front end program, and a few got rich selling theirs to the rest of us. I now have more computing power under the palm of my hand than my whole university had when I was a freshman there.

With all this new computing power the literature in the 1970's began to reflect a new concept: stormwater master planning. The idea was that I could construct a hydrology model (how much water how often?) and hydraulics model (how fast and high does the water from the hydrology model go?) of a watershed and then do "what if" analysis until I found the perfect solution to flooding problems – current problems and those only imagined. As a local community, it suddenly became too hard to do stormwater by yourself. But we consultants were glad to help out. The "regional treatment" mantra was everywhere mouthed by knowing experts.

Why Detention Fails

- Wrong design approach
- Errors in calculation
- Single design storm criteria
- Design storm too large
- Poor construction practice
- Bad outlet design
- Low storage volume
- Poor maintenance
- Volume not considered
- Peak flow timing not considered

By 1985 hundreds of master plans had been developed... and one or two were actually built the way they were planned. This led to the coining of a new understanding of how the world really works, called the "Hydro-Illogical Cycle." In this cycle local governments proceed from flooding to panic, to planning, and to procrastination until the next flood. Round and round they go.

A lot of things conspire to cause chronic flooding. Only five of them are physical: more water than before, a clogged or broken system, a system designed too small in the first place, homes located in the wrong place and an act of God... or someone more diabolical. All the rest of the reasons are institutional in nature. So it takes a lot more than a spiffy model and a Ph.D. to make a stormwater master plan a success. That's the easy part. Many stormwater engineers hung up their PCs and learned consensus building, stormwater finance (stormwater utilities sprang up about now), and public relations.

With that, more and more flooding problems were solved on a neighborhood, if not watershed, basis. Some of us began to think we would need to become financial planners or life insurance salesmen in a few years, when all the master plans were done, and all the problems were solved once and for all time. Maybe even .com entrepreneurs.

We couldn't have been more wrong.

The New Breed of Stormwater Paradigms

I think you're beginning to see the pattern. University professors and other troublemakers begin to publish ideas about how to solve current problems. New paradigms emerge. Each stormwater paradigm solves the immediate problem of the past paradigm, and creates a more insidious problem of its own. Thus long term employment is guaranteed.

Or, as we will shortly see, knowledge and technology create a real or perceived need for higher, more demanding, levels of stormwater management... and regulation.

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It's not that the past paradigms disappear. They are alive and well in various parts of the country. In fact, its at this time in my standard lecture on stormwater paradigms that people start to fidget and look at the floor. Why? Because this or that paradigm is where they now live. And they suspect there are quite a few paradigm shifts ahead of them - and they are no where near career retirement!

Back to the story line.

About this time the first Section 208 area-wide studies were just being completed. In them there was learned discussion about CSO problems, detailed evaluation of wastewater point source controls and technology, expert industrial pollution source and assessment strategies, and...vague hand waving about stormwater runoff.

No one important was sure what to do about this mysterious source of pollution. Actually no one was even sure just how much of a real problem stormwater runoff was. Opinions multiplied like fecal colonies on a warm summer day. And there was some similarity. Data was scarce, and reliable data non-existent. But everyone, in their heart-of-hearts, knew that urban streams are trashed – and runoff is an unindicted co-conspirator. EPA to the rescue.

Paradigm #6 – Oh, And Don't Pollute Either Just when you think you are seeing the light at the end of the stormwater tunnel along comes the regulatory freight train. The Phase I stormwater regulations were that freight train. Growing out of the 1987 Water Quality Act, the 1986 publication of the National Urban Runoff Program (NURP) final report, and 305(b) reports stormwater runoff became public (works) enemy number one.

The stormwater quality regulations hit some local governments like a two-by-four from the blind side. Many cities and counties spent large sums of money on untested structural Best Management Practices and unworkable regulatory controls, to meet ill defined standards of Maximum Extent Practicable, enforced by understaffed regulators with no budget increase despite greatly increased workloads. There, does everybody feel better?

After a lot of thrashing about, some very insightful articles about BMPs being pollutant deathtraps, horror stories about 80% failure rates for infiltration basins, and untargeted million dollar stormwater quality models, saner heads prevailed and some fairly effective programs emerged, and are still emerging. And the stage was set for the drafting of the Phase II regulations now upon us.

The urban infrastructure also went through a metamorphosis. Remember the first paradigm? Well, ditches started looking good again. Only now we are calling them “grassy swales,” and the wettest swampy ones “wetland swales.” Open fields have had a makeover too. Only they are engineered and termed “buffers with flow spreaders” or “riparian filter strips.” Also souped-up detention ponds began to appear, and a plethora of ultra-urban and commercial devices looking for all the world like mini-wastewater treatment plants.

Designs became much more complex as a raft of rules-of-thumb emerged to capture and treat a certain stormwater quality volume. We are not sure what the right volume is, or even if a volume approach is right, but we hope to impact the flow regime sufficiently to positively impact the stream water quality and overall stream health. Though few programs have anything remotely resembling a comprehensive monitoring program to measure success. Maybe that's smart!

If you think detention pond programs are hard to make successful just try BMP programs. Many cities failed, many more shied away from the whole thing, delaying it until regulators made them move ahead – like they will need to do under Phase II.

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But there were more questions than answers. For example, we measure fecal coliform because we can. Not because it's the right thing to do. Who knows what the right metals numbers are for Mill Creek in West Anywhere? What is it we are protecting anyway? When do we know we've done enough?

Engineers would have been better off not asking those questions... it led to the next paradigm.

Paradigm #7 – It's The Ecology Stupid With some deference to our ex-president and his first campaign, about that time frame a new concept of measuring stream health and targeting stormwater program efforts began to emerge: bio-criteria. And it makes sense. If the macroinvertebrate community is happy then the stream is happy, maybe the stream water quality is fine. So, under this paradigm, our stream restoration or conservation target is some measure of biological health, and our stormwater program is focused on how to attain and maintain this health.

This concept led to the development of various types of bio-criteria. Rapid bio-assessment protocols emerged and were modified for various states or regions. Groups one, two and three taxa were popularly defined, scoring sheets developed, and armies of willing volunteers trained. Even some old, bald engineers can do a pretty good caddisfly dance.

The problem comes in when we try to come to agreement on what healthy is, how we measure it, and what the cause of ill health is. Is it natural seasonal variation? Has there been a die off due to disease not pollution? Is the sampling repeatable? Is this sluggish stream type naturally low in Group One Taxa or is it impaired? Is the reference stream really applicable to this situation? Will that land use change really impact this rating, and if so, by how much? There may be twenty-five reasons for a certain stream rating – only half of them pertinent to stormwater runoff.

So, if we can solve the biology problem, we have solved the problem, right? “Right,” you say. And to solve that problem we need to be able to change the way the riparian corridor is managed, the way the floodplain is regulated, the way the watershed land is used, the way wastewater is permitted, and the way runoff is developed in the headwaters. And we come to an interesting conclusion...

Paradigm #8 – Water is Water is Watershed I'm not normally given to conspiracy theory. But there seems to be a not-so-secret conspiracy going down concerning the importance of watersheds, and working at a watershed level. It began as the mantra of the environmental left, and is now being adopted by everyone.

There was a great convergence that occurred on the regulatory side. Everybody is thinking watershed-based programs are a pretty good idea. EPA is permitting on a watershed basis. Pollutant trading within a watershed is coming into its own. If NPDES is a large wave, TMDL is a tsunami. Depending on changes made in the current administration, this regulatory program has the potential to dwarf and trump all other water efforts within the next ten years. And it will be done on a watershed basis.

We are coming to the realization, even organizationally, that water is water. Wastewater, groundwater, drinking water, stormwater, rainfall, seawater, lakes, and atmospheric water are all part of that circle-of-life thing. Our artificial organizational and political boundaries make no sense from this perspective. This has led to the formation of a large number of regional water planning and regulatory bodies. Of course Florida and several other states have been organized this way for years (lands on other continents even longer). But even they are feeling a fresh wind of change coming.

We are also coming to the understanding that everything that happens in the watershed impacts the stream and riparian corridor. So, under this paradigm there are attempts to change the way things happen in watersheds: development standards, transportation, car washes, gardening, oil changing, trash disposal, landscaping, use of private lands, open space access, floodplain uses, zoning potential, subdivision ordinances, school curricula, and on and on.

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Our thought has been, “surely, when done right, this will solve all the stormwater problems.” We have found the fabled Pierian spring of stormwater wisdom. Well, the first public meeting you hold should be enough to change that thought forever.

The world does not revolve around stormwater. It does not even revolve around water. When we enter into the watershed we enter into a competition for the attention and resources of normal people, and we enter into a world where our priorities may never float to the top.

Some of the drawbacks of the watershed approach are that it often bites off too big a land chunk for citizens to relate, it involves watersheds but most citizens do not know a watershed from a woodshed, it does not address the problems at the design and development process stage where many occur in the first place, and it involves groups that do not necessarily have authority to accomplish the kinds of things needed to be done. But the watershed groups, and others, are beginning to succeed in bringing about a new way of thinking about stormwater, a new a paradigm... and, since I'm at my word limit, the last one we'll talk about.

Paradigm #9 – Green and Bear It There is a multi-faceted green revolution going on in stormwater. The basic issues are these. Urban sprawl creates an environment that is ultimately not good for either man or beast. This type of development is NOT inevitable. Through a combination of structural and institutional practices functional, environmentally friendly, sustainable and beautiful living environments can be created. Surface and stormwater management play a large role in this movement.

There have been many popularly named approaches that address some or all of this including: Low Impact Development, Green Infrastructure, Better Site Design, Smart Growth, Conservation Development, Sustainable Development, and so on.

It basically consists of a network of inter-connected linear and patch areas that seeks to sustain life and enrich the quality of life by:

- mimicking “acceptable” hydrology
- enhancing natural diversity and beauty
- balancing ecological preservation/conservation with economic growth & development
- building systems that are sustainable & maintainable
- working at a small, integrated scale with accumulated results.

Some impressive successes have been trumpeted in conferences and government funded publications. And most are real and wonderful. There has also been some strong grumbling about the fact that it is not as easy to move to, and maintain, this paradigm as some would have it.



An interesting array of followers support many of these concepts. I remember speaking at a public meeting held concerning Better Site Design Principles. After I made a presentation on a comprehensive design approach to mitigate the biggest impacts of development, a man stood in the back to make a comment. He identified himself as the president of the statewide Homebuilders Association. I thought, “oh no, here it comes.” But he said, “I just want you to know that the homebuilders wholeheartedly support these principles – they make environmental sense and they allow us to build infrastructure that costs up to 35% less, but to sell lots at the same price.” There is a God!

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In any case, this paradigm returns to the small scale, distributed and accumulative approach that can accomplish lots of real things on the ground because it is typically enforced by local governments (sometimes through state mandate as in Maryland), and can also be a failure if it is not strongly supported by local governments (politicians included). So it is no accident that the most popular and successful methods are those that have a strong, passionate, and smooth talking (I mean “well spoken”) advocate who can paint the vision and bring about flourishing demonstration projects.

From Paradigm to Paradigm

Well, those are the paradigms as I understand them. You may be thinking that you will never get past paradigm six... or two. Regulatory requirements will prove you wrong.

Remember, is it much easier to know what the next paradigm is than to move into the next paradigm. As you look at moving to a new paradigm look at this brief list of key ingredients for success:


1. A Visionary or Two
2. A “Compelling Case for Change”
3. Collaborative Staff, Partners & Local Champions
4. Great Communication, Education & Involvement
5. Realistic Alternatives to Current Practice
6. Regulatory Sticks and Carrots
7. Useful Tools & Practical Guidance
8. Stable, Adequate Funding
9. A Couple Good Examples
10. About Five Years

Will there be more paradigms? As long as there are stormwater practitioners and regulators there will be new paradigms. I think the next one, already emerging will be the handling of stormwater as a commodity and the use of market forces for pollution control. We can already see it in pollution trading, riparian corridor credits, underground injection of stormwater for drinking water use, and stormwater irrigation systems.

So fear not. You can catch up in the right way. Move out (and draw fire). You may be that visionary for your community, your company, or even your neighborhood. But remember to have mercy on someone a couple paradigms back. Someday it may be you !!

That's it. Good luck. Call if you feel overwhelmed.

– *Andy Reese is Vice President for AMEC Earth & Environmental, Inc. and is located in Nashville, Tennessee. He is a consultant, writer, and popular speaker on stormwater management.*

Christopher B. Burke Engineering, Ltd.	
9575 W. Higgins Road, Suite 600 Rosemont, IL 60018 (847) 823-0500	Office Locations: Rosemont, IL St. Charles, IL New Lenox, IL Peoria, IL Indianapolis, IN Crown Point, IN Fort Wayne, IN
	<ul style="list-style-type: none">• <i>Water Resources</i>• <i>Stormwater Management</i>• <i>Environmental</i>• <i>Transportation</i>• <i>Structural</i>• <i>Mechanical</i>• <i>Surveying</i>