The City of Wimberley, Texas, is (at the time of this writing) in the process of planning for the implantation of a wastewater system. The "first phase" of this system was to serve "the Square", a highly impacted commercial core, and the surrounding areas. All throughout this planning process, the only strategy being considered was a conventional "big-pipe" collection system, leading to one large activated sludge treatment plant. I was asked to make a presentation to the City's Water & Wastewater Advisory Board about a decentralized concept strategy for wastewater system development there. This led to further discussions within the community, and the editor/publisher of a local political blog, the Hays County Roundup, asked me to write a piece explaining why a decentralized concept strategy, entailing "alternative" choices for collection and treatment technology "should" be considered. The first piece below is what I offered, and it was published in the blog. A comment issued in response to that piece led to writing the second piece, to provide more detail of just how a decentralized concept strategy might be implemented in Wimberley. Together they provide the overarching rationale and a review of the system development strategy for one particular situation.

WATER – *ALL* WATER – IS A RESOURCE HERE!

In terms of wastewater management, Wimberley has before it the opportunity to leap into the 21st century. From all indications, however, it appears poised to make an expensive retreat to the 19th century.

The leap into the 21st century is about how we should be managing water resources in this whole region, but particularly in the Wimberley Valley. We need to stop managing wastewater as if it were a nuisance, looking for someplace to make it go "away". We need to start managing it, right from where it's generated, as a ***resource***, first and foremost. Because the water realities are that this "waste" water ***must*** become a resource, not a waste.

The retreat into the 19th century, that's the wastewater plan the City is working on. A presentation about it posted on the City's web site – my only source of information, as the City is being very tight-fisted with the actual planning documents – informs that the planners have made a conscious decision to consider one, and only one, infrastructure model for delivering wastewater service. This is a very costly conventional centralized collection system piping wastewater from the entire service area to one large treatment plant. Although water supply is a critical issue in the Wimberley Valley, that presentation offers no plan for beneficial use of the water once it gets to "away" and issues from a treatment plant.

So, you might be asking, what is wrong with that? Isn't that how cities do wastewater service, pipe it "away" and dump it? Yeah, they have in the past. But, going forward, should Wimberley do it that way, given the current and projected water realities? That is the question the planners appear to be scrupulously avoiding. Well then, what else might they look at?

I was asked to make a presentation to the Wimberley Water & Wastewater Advisory Board about "decentralized wastewater". I made the presentation on February 23, 2009, laying out a "decentralized concept" strategy and the means and methods for implementing it, with particular emphasis on the circumstances and opportunities in Wimberley. Cut to its essence, the decentralized concept holds that wastewater is most effectively and efficiently managed by treating it – and beneficially reusing it to the maximum extent attainable – as close to where it is generated as practical. The system focuses on managing the *water resource* rather than on a pipe network to make go "away" what is perceived solely as a nuisance.

The most visible and ubiquitous example of "decentralized" is the individual on-site wastewater system – the so-called "septic" system. In a "decentralized concept" strategy, however, these individual systems would be actively managed and would focus on reusing the water – like in a subsurface drip irrigation

system – rather than making it go "away" on each lot. In any case, an individual system for each home or business is often not the best arrangement, for any number of reasons. It may be more efficient and effective to collectivize treatment and/or reuse to some degree, as determined by the circumstances at hand. Factors to consider may include topography, soil and site conditions, type of development being served – both existing and planned – and indeed the opportunities for beneficial use of this *water resource*.

The technical details of how the decentralized concept might be executed in Wimberley and the reasons why this may be a *more fiscally reasonable, more societally responsible and more environmentally benign* strategy get into minutia, best deferred to another forum. Here, it is most important to understand ***why*** Wimberley should consider such strategies on a co-equal basis with the conventional centralized strategy.

I have championed and advocated this decentralized concept strategy for almost 25 years, laying it out for a consistently deaf mainstream. However, it is no longer just forward-looking iconoclasts like me that are paying attention now. Other voices are joining in. Like Paul Brown, president of Camp, Dresser, McKee, one of the largest national engineering firms – a voice from the very heart of the mainstream engineering field.

In *Cities of the Future*, Brown writes that we are presently in a "fourth paradigm" of water resources management. We'll skip the full history lesson, and just note that Brown's "third paradigm" originated in the 19th century. The industrial revolution was in full force, city populations were exploding, the stuff was running in the streets, sewage-borne disease was rampant. This "third paradigm" was all about getting the stuff out of the streets, out of the city, away from the people. Brown calls it a "fast conveyance urban drainage system", indeed focused solely on making the stuff go "away", to be discharged without treatment into receiving waters.

The "fourth paradigm" commenced in the mid-20th century, when it was recognized that the waters at "away" were being fouled and treatment prior to discharge was required. Brown writes: "… our *fourth paradigm* … could also be called the '*end-of-pipe control*' because the predominant point of control … is where the polluted discharge enters the fast conveyance system or the receiving water body." Brown then observes about this fourth paradigm that "… no matter how much money is spent to reduce controllable regulated sources of pollution, the integrity of water bodies has been severely impaired and will remain so if the fast conveyance, end of pipe treatment paradigm alone continues to be the prevailing model." In short, he is saying, this management model is not sustainable.

Indeed, Brown proceeds to introduce sustainability as a necessary goal for water resources management, and then describes the "fifth paradigm", toward which he asserts society needs to move: "The need for ecological sustainability of watersheds and water resources leads us to a *fifth paradigm* of water management, a model of sustainable and resilient waters and watersheds. This paradigm adopts a holistic, systems approach to the watershed, rather than a functionally discrete focus on individual components characteristic of earlier models."

After describing the drivers and benefits of this "fifth paradigm", including the idea that "all components of water supply, stormwater, and wastewater will be managed in a closed loop", Brown states, "Closing the water loop may require ***decentralization*** of some components of the urban water cycle in contrast to the current highly centralized regional systems employing long distance water and wastewater transfers." [emphasis added]

This shows there is nothing compelling about a centralized wastewater system that makes the stuff go "away", rather it is largely just a tradition. There is increasing recognition that the way we've always done it may not be the way it should be done in the future. Today we face 21st century problems and

issues. A system architecture developed to address the problems perceived in 19th century cities may not be the best response to these current realities in a small town, and it is by no means the *only* possible response, much as those running the planning process in Wimberley may like to assert that it is.

Wimberley is ground zero for the "fifth paradigm". The water resources realities of the Wimberley Valley demand that we get by that 19th century idea that "waste" water management is all about making go "away" what is perceived solely as a nuisance. Rather, we need to recognize from the start that this water is a ***resource*** that should be husbanded to the maximum extent practical. As Brown stated, this resource should be addressed by integrating it into a holistic water resources management strategy, not segregating it in a traditional wastewater system.

All concerned should encourage the planners to take another look, to consider the full range of options that are available for formulating a water resources management strategy for Wimberley, to not restrict their studies only to an infrastructure model that is informed by 19th century issues and attitudes. Rather they should move boldly to address the water realities of Wimberley in the 21st century.

WHERE'S THE BEEF?

In response to my piece about Wimberley bypassing its chance to move forward with a wastewater system that recognizes the 21st century water realities in the Wimberley Valley, a commenter stated, "When you strip away all the pretty verbiage, what—precisely—are you talking about here? I've read this twice, and still looking for the meat." While I don't agree there was no "meat" in that piece, here I will attempt to put across, as best I can in this limited medium, an idea of how a decentralized concept strategy might work in Wimberley.

To get right to it, the decentralized concept employs three basic tools: (1) effluent sewerage, (2) "fail-safe" treatment, and (3) beneficial reuse.

Effluent sewerage is a collection system that differs from a conventional "big-pipe" system in that an interceptor tank – so called because it intercepts the big chunks, it's really just a septic tank – is installed at the source of wastewater generation, and only the liquefied effluent out of the interceptor tank is collected to a treatment center. Because there are no settleable solids in the wastewater transported in these sewers, they can use small-diameter pipes – 2 to 4 inches are typical – which can be very flexibly routed. These pipes can run at very small slopes – even locally negative grades are allowed, creating a "sink trap" in the line, through which water will be forced by gravity, just like in your sink drain.

Because of this flexibility, these pipes can generally run with the lay of the land, so can be installed in shallow, narrow trenches. Cleanouts rather than manholes provide maintenance access for effluent sewers. Manholes, besides being expensive, are a major source of infiltration/inflow in big-pipe sewers. Along with watertight joints that small pipes facilitate, eliminating manholes practically eliminates infiltration and inflow of stormwater.

All of these factors make effluent sewers less costly than big-pipe sewers. Adding on the cost of the interceptor tanks, a neighborhood-scale effluent sewer system is typically about the same cost as a big-pipe sewer system when installed prior to the development it serves. In the already built areas of Wimberley – especially in the Square area – the narrow, shallow effluent sewer trenches would be very much less disruptive than would large, big-pipe trenches, with their attendant large machines and bulky trench shoring structures. Entailing much less excavation, installation of effluent sewers would go much faster, so the disruption would last a much shorter time. The traffic control problem would be much less

extensive, as would the area of pavement that would have to be restored. All these factors would drive up the cost of big-pipe sewers relative to effluent sewers in this already built environment.

Then too as you go downstream, gathering more and more flow in the sewer main, effluent sewer pipes do not get much bigger, so even if used in a fully centralized system, the largest diameter effluent sewers would still be fairly small and easy to install in shallow, narrow trenches. So the greater the extent of the sewer system, the greater the savings an effluent sewer would provide.

But recall that the decentralized concept urges treating and reusing the water close to where it is generated, and this would eliminate all except the local area collection system, saving huge sums by eliminating all the larger pipes that would do nothing but move pollution from place to place, not really addressing the fundamental water management issues. Overall then, the effluent sewer system would be much less costly in Wimberley than a conventional big-pipe system.

As just noted, some of these savings come about by decentralizing the treatment system, installing multiple smaller plants, each serving a limited area. While determining the number and size of treatment centers awaits a planning effort, a decentralized system implies the treatment centers may be in the neighborhood, close to houses and businesses. This is where judicious choice of treatment technology becomes critical.

The second basic tool of the decentralized concept is "fail-safe" treatment. I always use the quotes because nothing is ever really fail-safe – any sort of treatment unit needs to be properly operated and maintained in order to continue producing the desired effluent quality. However, some technologies are, by their very nature, more robust, inherently resistant to upsets, and so can routinely operate with minimal active oversight. They are also visually unobtrusive so are essentially invisible, and produce no odors or noise, so they can be installed in the neighborhood without creating a stink, either literally or figuratively.

One of these technologies is the high performance biofiltration concept, the sort of process that best suits the circumstances in Wimberley. This process is the evolutionary end point of recirculating sand filter technology, engineered to operate most consistently and reliably, and to facilitate what minimal operations and maintenance activities as are required. That basic technology has an excellent reputation for producing a consistently very high effluent quality. An EPA report states the process is "… ideally suited to rural communities, small clusters of homes, individual residences and business establishments. [This process] can achieve advanced secondary or even tertiary levels of treatment consistently with a minimum of attention."

People's expectations of what a wastewater treatment plant is like are badly colored by activated sludge plants, which is the technology usually used at municipal scale treatment plants – and the only one that the current planning process is considering. Some people also know this technology, mostly unfavorably, from the "aerobic" systems (ATUs) that many in this area have as on-site wastewater systems. This technology is inherently unstable, readily subject to being upset, so odors are not at all uncommon. Entailing vigorous mixing of the wastewater to aerate it, this process is also audibly obtrusive.

The high performance biofiltration process is a whole different animal. There is no violent mixing of the wastewater, so potential for odor production is minimal to begin with, and the entire system is sealed and "breathes" through soil vents that will scrub out odors in any case. Power draw is therefore quite low – so the energy cost of this process is significantly less than it is for activated sludge – and power is not required to maintain the basic treatment process, as is absolutely critical to the activated sludge process. Rather power is only required to move wastewater to the top of the filter bed. The actual treatment process is passive, imparted by the microbes growing on the filter media as the water flows by gravity

down through the filter bed. If pump function is lost for any reason, the process just sits there patiently waiting for it to be restored, then picks up again without missing a beat.

This is in high contrast to activated sludge, where loss of power means you lose the treatment process, and it typically takes some time to re-establish it, all the while spewing forth poorly treated effluent. This circumstance is well-known to those familiar with ATUs. My realtor cousin once put it very colorfully – they "puke solids".

The inherently robust nature allows a high performance biofiltration treatment unit to be installed in the neighborhood, close to houses and businesses. Surround the treatment center with a landscaping screen and it would not intrude on the neighbors in any way – audibly, visually, or due to odors. And since the treatment process is inherently stable, it will consistently and reliably produce high quality effluent with minimal active oversight, so having many dispersed treatment centers does not create untenable operating liabilities.

Once the reclaimed water issues from the treatment unit, the third basic tool of the decentralized concept comes into play. In a water-challenged area like the Wimberley Valley, the focus needs to be on ***integrated water management*** – that "fifth paradigm" approach I reviewed previously – not on "wastewater management" viewed in isolation. While other uses, like toilet flushing, may be entertained, the most ubiquitous and readily available opportunity to beneficially reuse this reclaimed water in Wimberley is landscape irrigation.

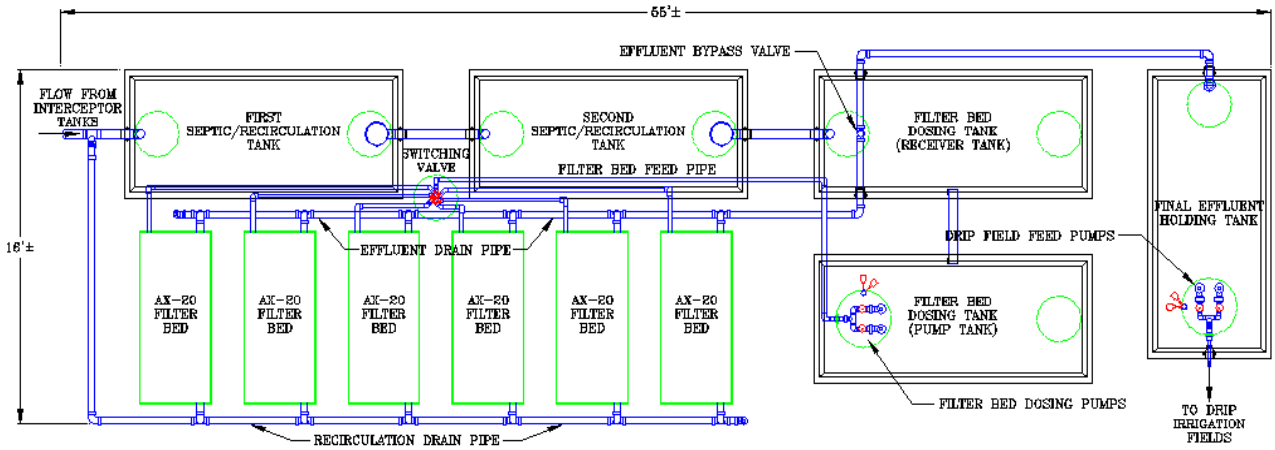
The aim would be to provide irrigation that would positively impact on the project and/or the community. One critic has asserted that no one would be willing to give up their property so a "drainfield" could be installed on it. That really misses the point. Rather than displacing development, dedicating greenspace to the sole function of making wastewater "go away", the idea would be to arrange each project so that reclaimed water would be used for irrigation to support that development, to beautify the grounds without creating an additional draw on this area's limited water supply.

In some places, the water could be used to beautify public places. I grew up near Dixon, Illinois, the hometown of Ronald Reagan. Since my youth, Dixon has been known as the "Petunia City". They have claimed parkways, placed planter boxes along sidewalks, etc., for flower beds to show off each year's crop of petunias, beautifying many public spaces throughout the city.

Wimberley could likewise lay claim to being a "florally enhanced community" by creating planter beds throughout the square, and perhaps in parkways throughout the community. These could be used to show off a "Hill Country aesthetic" by planting a palette of native wildflowers and shrubs. These beds could "absorb" irrigation water all year round, with any water that does not evapotranspirate percolating into the ground, just as it does now in "septic" system drainfields throughout this area. Only in this case, the water would be highly treated before it even enters the soil. And it would provide for highly distributed dispersal of the reclaimed water while supporting a community value.

The foregoing offers the general ideas and concepts that might be employed to create a decentralized concept strategy in Wimberley, but every situation poses its own unique set of circumstances – the devil will always be in the details. I will close with a brief review of an example project, a 16-unit condo project presently being proposed on a tract near the Square.

A conservative estimate of the design flow rate for a project-scale wastewater system to serve these condos is 2,880 gallons/day. A high performance biofiltration concept treatment center with a capacity of 3,000 gallons/day is shown in the figure below, showing that the area required to house it would be about the size of what might be occupied by one condo unit.



3,000 GALLON/DAY TREATMENT UNIT

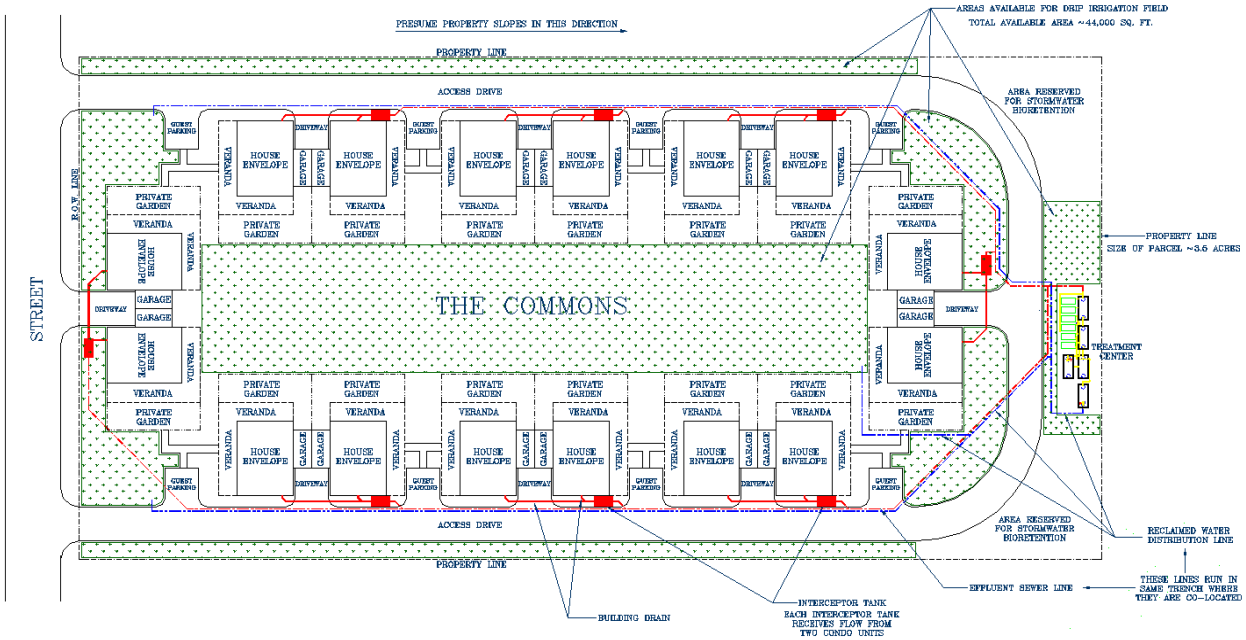
As reviewed previously, all components of this treatment center would be sealed so that odors would not emanate from it, and the only mechanical components are submersible pumps, which being under water inside a tank would produce no noise. The treatment center yard would be enclosed by a landscape screen – part of the grounds beautification plan, irrigated by the reclaimed water coming out of the treatment center – so even the tank hatches and filter bed covers would be hidden from view. Allowing some space around the components, the total area covered by this yard would be less than 0.05 acre. As was noted, operations and maintenance requirements would be minimal, perhaps one inspection per month, with tank pumping and filter bed cleaning at intervals of several years.

One idea for the layout of this condo project is illustrated in the figure below. Each pair of condos would be served by an interceptor tank. These tanks would be located where they could be conveniently accessed for inspection and pumping. Inspections would be conducted annually, and a typical pumping interval would be in excess of 5 years, entailing a very minimal intrusion.

The liquefied effluent from the interceptor tanks would flow through small-diameter effluent sewers to the treatment center. The project would be configured so that all the collection lines would flow by gravity to the treatment center. These lines could be installed in narrow trenches, likely no deeper than 3 feet, so would be relatively inexpensive to install.

Reclaimed water coming out of the treatment center would be redistributed throughout the project to irrigate plantings installed to beautify the grounds, as illustrated in the figure. Most of this redistribution pipeline would be dirt cheap, since as illustrated in the figure you could just drop a second pipe into the same trench used for the collection lines.

All this irrigation would be executed with a ***subsurface*** drip irrigation system. This sequesters the reclaimed water below ground, making the prospects for human contact very small, while also enhancing the irrigation efficiency. A general criterion for sizing the drip irrigation field is a loading rate of 0.1 gallon/square foot/day, or a field area of 10 square feet per gallon/day of design flow rate. For the projected design flow rate of 2,880 gallons/day on this project, the total area required would be 28,800 square feet, or about 2/3 of an acre. As the figure below illustrates, this would be somewhat less than the total pervious (greenspace) area likely to be on such a project, so housing this drip field within the project would not be an issue, in terms of the space required.



16-CONDO UNIT PROJECT

Without belaboring the details, a preliminary estimate of the cost of the collection, treatment and redistribution system is about $7,000 per condo unit. The drip irrigation field would be in addition to this, but that of course is part of the grounds beautification costs in any case. Given a desire to implement high efficiency irrigation – which should be of paramount concern in Wimberley in any case – the irrigation system supporting that grounds beautification would be subsurface drip anyway, so the drip field for the reclaimed water would not impart an "extra" cost.

While broad-brush and a bit simplistic, this example illustrates that a project-scale wastewater management system is readily doable, and apparently quite affordable relative to the projected $24,000+ cost per connection of the proposed "first phase" centralized system that Wimberley is currently considering (an estimate that also does not include any costs for reuse of the reclaimed water). This distributed treatment unit would be a part of the overall City of Wimberley wastewater system, under unified management by the city's operating agent, not an independent "on-site" system controlled by the project owner. That is the essential characteristic that differentiates a ***decentralized concept system*** from a collection of decentralized systems.

I hope this sheds some light on how a decentralized concept system might work in Wimberley. But this is just an example, and it is by no means suggested that a project-scale treatment center for every project is THE way to go. It remains to include this sort of option in the on-going planning process, to evaluate it on a co-equal basis with the conventional centralized option, to determine what would be the most fiscally reasonable, most societally responsible, and most environmentally benign way to implement a community wastewater management system in Wimberley.