MWRD, Your Sludge is Showing

April 2024 by Richard Lanyon

Sewage consists of water and a lot of inorganic and organic substances that for simplicity's sake are called *bad stuff*. Sewage is processed at Metropolitan Water Reclamation District water reclamation plants to separate the water from the bad stuff. The reclaimed water retains a tiny amount of the bad stuff, but not enough to violate the Clean Water Act. The reclaimed water complies with Illinois water quality standards When the reclaimed water is discharged to a canal or river, aquatic critters can survive, and if the reclaimed water is disinfected, it's okay for human contact during recreation, such as boating, but not for drinking.

MWRD has seven water reclamation plants, but only three process the bad stuff, also called *sewage sludge*, or just *sludge*. The two biggest sludge processing plants are the Calumet plant, on Chicago's far south side, and the Stickney plant, in the village of the same name. The third, in Hanover Park, is very small by comparison and is left out of this discussion. Sludge from the other four plants is processed at the Stickney plant.

Sludge is that which settles on the bottom of settling tanks, with a consistency like a cream soup, but dark gray in color. After anaerobic digestion for several days, most of the pathogens are destroyed and the volatile acids are reduced, but it is still very soupy. At this point, the two big plants handle sludge differently, but both plants end up with the same product, called *wet biosolids*. Part of the sludge at the Stickney plant is processed differently and is called *dry biosolids*, or *pellets*.

Stickney Plant Sludge Processing

Sludge is taken for a spin in huge centrifuge machines. The liquid spun out, called *centrate*, is processed to recover some useful byproducts. The more solid product of the centrifuge is called *centrifuge cake*. Actually, if you saw it drop on to the conveyor belt, you might think of a black blob. It has the consistency of Jello and it jiggles as it goes along the conveyor belt. It is about 75 percent water. *See Exhibits 1 and 2.*

Centrifuge cake has no useful value and most of the water must be eliminated to make it useful. This process is called *drying* and it can be accomplished thermally, using heat to evaporate the water, or alternatively, the centrifuge cake can be spread out on a firm surface and allowed to dry in the open air. About one-third of the centrifuge cake is thermally dried using biogas from the digestion tanks as a heat source. Natural gas is used when there is an insufficient supply of biogas. The thermally dried sludge, politely called biosolids when dry is in the form of pellets and contain only five percent water. The pellets are sold in bulk to a fertilizer manufacturer who blends the pellets with other chemicals to produce a commercial fertilizer. A contractor operates the thermal drying facility for the MWRD. *See Exhibit 3.*

The remainder of the centrifuge cake is hauled five miles by rail to the drying area where it is dumped and mechanically spread out to dry in the open air. With continual mechanical agitation

Text continues on page 4.

Exhibit 1. Aerial view of part of the Stickney plant looking southeasterly on June 5, 2023. At right is the centrifuge building and rail car loading facility. Left of center is the thermal drying facility. An overhead pipeline feeds centrifuge cake directly to the thermal drying facility from the centrifuge building. The Central Avenue overpass cuts diagonally, disappearing into the background. *Photograph from the internet, credit Eric Jones*.

Exhibit 2. Centrifuge for dewatering sludge at the Stickney plant. Centrate is piped to another facility for processing while the cake drops to a conveyor on the lower level. *Photograph courtesy of the MWRD.*

Exhibit 3. Pellets produced by a thermal dryer. *Photograph by author.*

and dry weather, the water content will be reduced to about 40% in about six weeks. This air-dried sludge, the wet biosolids, has the consistency of garden dirt. Wet biosolids is then loaded onto large diesel-driven trucks and most is hauled to farmland and applied as a soil amendment. Biosolids is not a fertilizer because it lacks the proper ratio of nitrogen, phosphorus, and potassium, but it adds organic material to the soil and improves soil tilth. *See Exhibits 4 through 8.*

Text continues on page 9.

Exhibit 4. The first step in air-drying of centrifuge cake or lagoon sludge is spreading it out over the paved drying surface. *Photograph courtesy of the MWRD.*

Exhibit 5. The second step in air-drying of centrifuge cake or lagoon sludge is breaking up the surface crust that forms from initial drying. Several passes over about six weeks are required to break up the surface crust and bring wetter sludge from below to the surface. *Photograph courtesy of the MWRD.*

Exhibit 6. After about six weeks the wet biosolids have been air-dried sufficiently to be scraped off the paved drying area and stockpiled for loading into diesel-driven trucks for delivery to the ultimate disposal or utilization sites. *Photograph courtesy of the MWRD.*

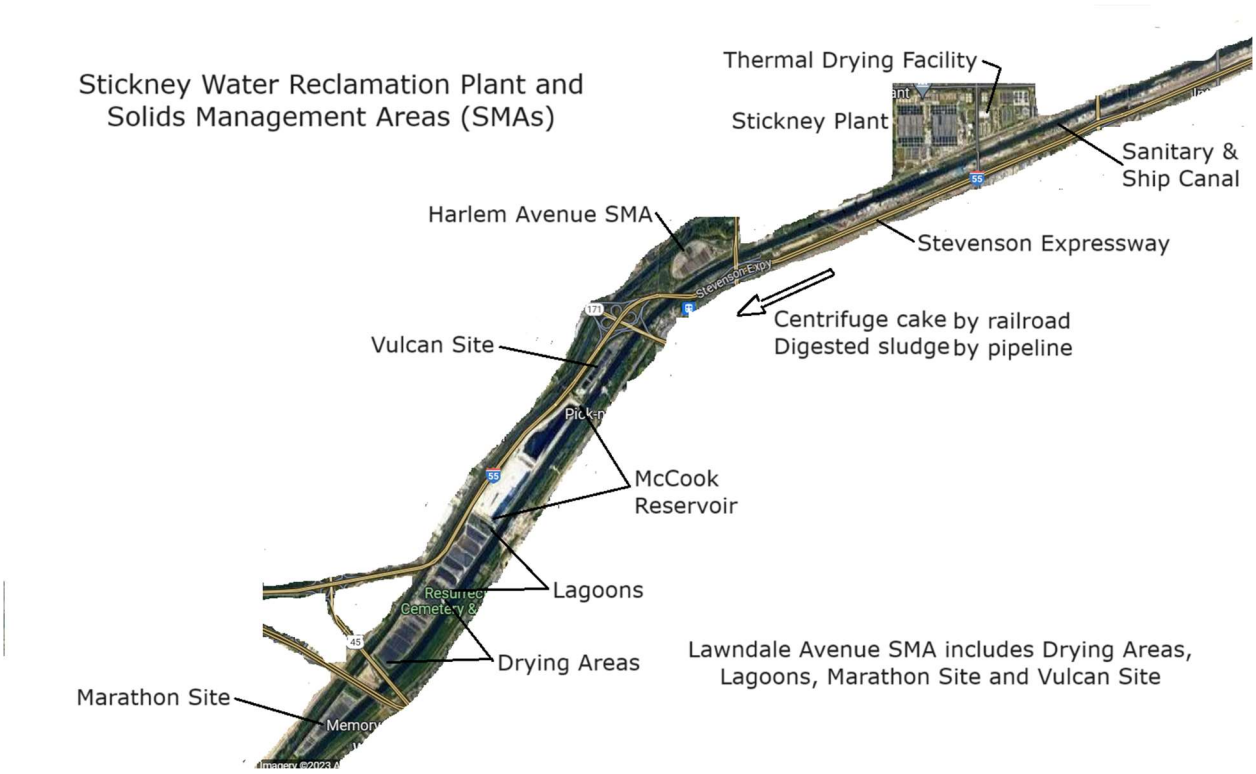

Exhibit 7. Location of the Stickney plant and associated sludge lagoons and drying areas. The thermal drying facility is located on the plant site, whereas the lagoons and drying areas are about five miles from the plant site. *Map from Google maps modified by author.*

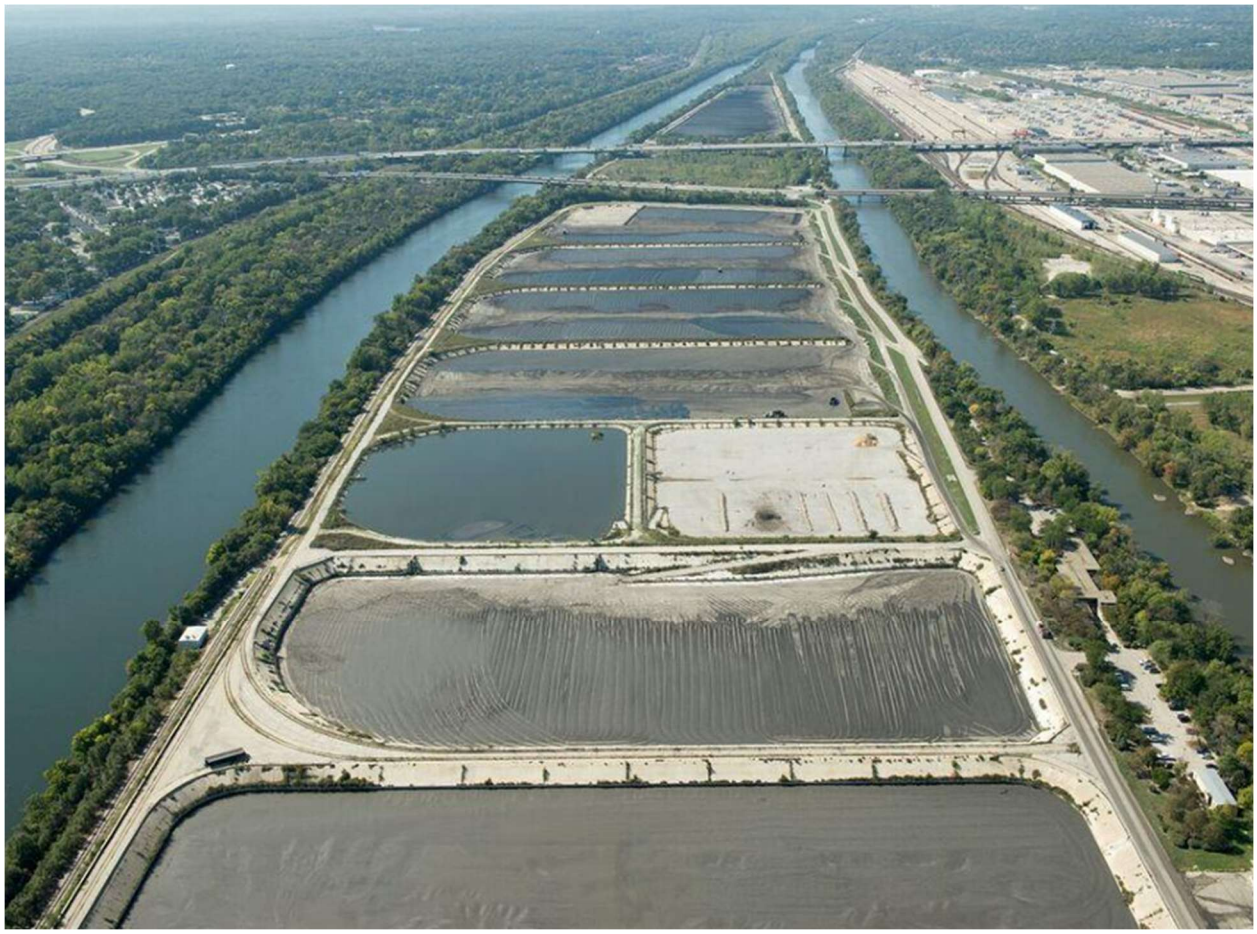

Exhibit 8. Aerial view of the sludge lagoons, foreground, and drying areas, center, looking southwest from above the McCook Reservoir. The Chicago Sanitary & Ship Canal is at left and the Des Plaines River at right. The MWRD railroad track runs along the left side of the lagoons and drying areas. Mannheim Road and the Illinois Tollway cross in the background. *Photograph courtesy of the MWRD.*

Thermal drying was practiced at the Stickney plant from 1950 to 1980, but was abandoned to avoid the use of coal and the cost of air pollution controls on aged equipment. Land application of wet biosolids began in the 1970s at various sites, some being distant from the Chicago area. Farmland application became an established practice in the 1990s with most farmland application sites being within 100 miles of the Chicago area.

To clear a site for the construction of the McCook Reservoir, it was determined in 1995 that 22 lagoons near the Stickney plant drying areas be eliminated. The loss of that sludge processing capacity was replaced with a thermal drying facility to process about one-third of the Stickney sludge production. The thermal drying facility shown in Exhibit 1 was placed in service in 2010.

The use of centrifuges to reduce the water content of sludge is efficient and reliable. However, if the centrifuges are down for maintenance or are insufficient to handle the continual flow of sludge, pumps and a pipeline are in place to convey digested sludge to the drying area. In this situation, sludge is placed in lagoons for longer term dewatering and aging for perhaps one or two seasons before it can be moved to the air-drying area.

Calumet Plant Sludge Processing

The Calumet plant has more area immediately adjacent to the plant site for lagoons and air-drying sites. As this site lacks centrifuges, after anaerobic digestion the soupy sludge is placed in lagoons for about two seasons for stabilization and water reduction. When the lagoon sludge is about the same consistency as centrifuge cake, it is moved to and spread out on air-drying sites and agitated until the water content is reduced to about 40 percent. Wet biosolids at Calumet is disposed in the same manner as disposal at Stickney. *See Exhibit 9.*

As this is written, MWRD is installing one centrifuge at the Calumet plant to handle an increase in sludge production. Since there isn't sufficient lagoon capacity to handle the additional amount of sludge, it was decided to install one centrifuge.

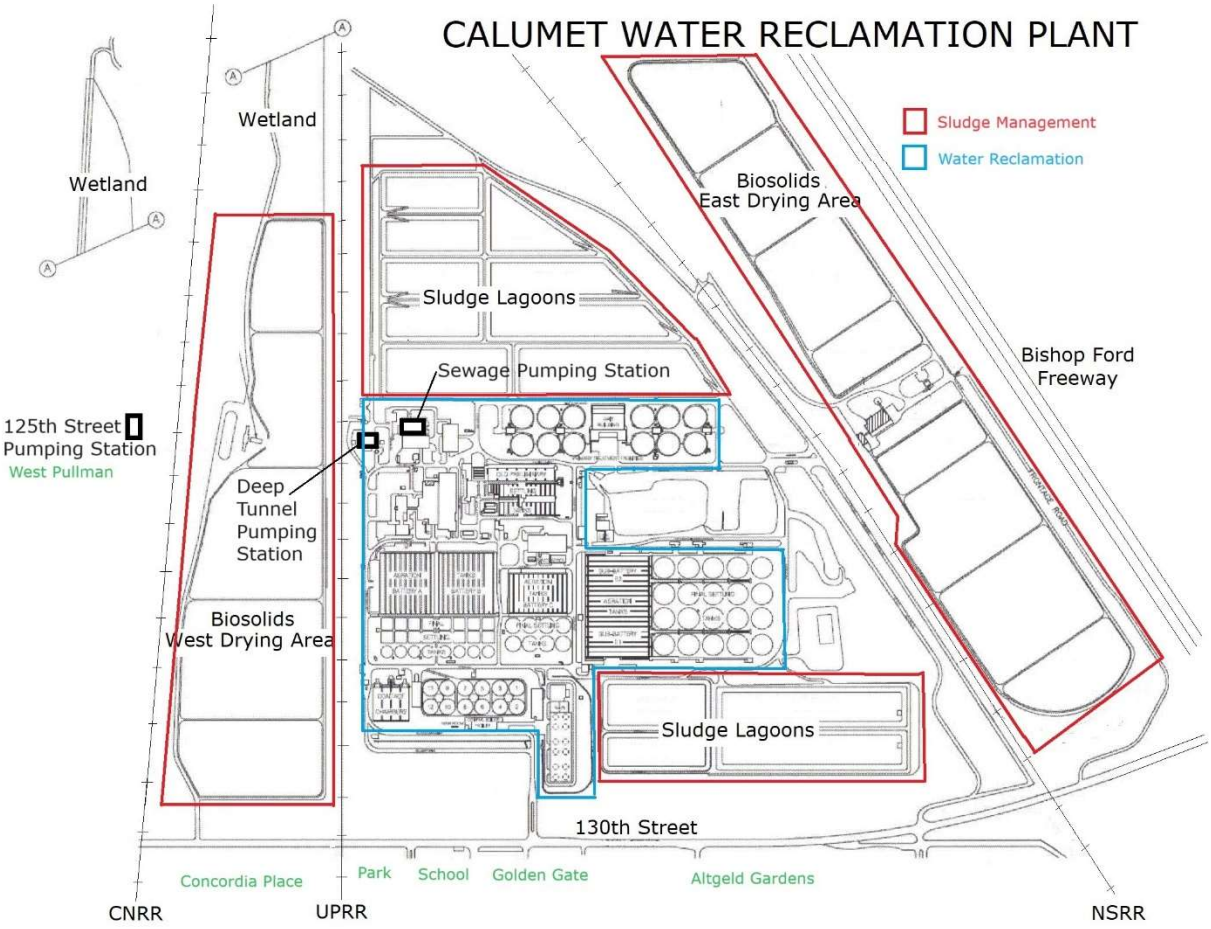

Exhibit 9. Calumet plant and associated sludge lagoons and drying areas. *Map courtesy of the MWRD modified by author.*

Sludge Cost Analysis

Air-drying is labor intensive and involves transport of the centrifuge cake (75 percent water) to the air-drying site and wet biosolids to farmland (40 percent water). Farmland owners will accept disposal and application of biosolids on their land at no cost to them. MWRD has advertised in the past to find a purchaser for the wet biosolids, but no bids were ever received. Using lagoons and air-drying for managing sludge is more costly than thermal drying.

Plant	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Budgeted	2024 Estimated
Solids Processing						
Calumet	181.01	173.36	165.36	188.74	238.60	625.24
Stickney	187.13	173.83	169.25	164.30	209.36	239.16
General Div.	--	--	--	--	--	--
Solids Utilization						
Calumet	59.20	49.93	293.34	313.28	369.77	319.54
Stickney	48.03	25.13	197.92	221.88	193.23	263.55
General Div.	218.97	165.07	--	--	--	--
Pelletizer Disposal						
Stickney	--	--	119.76	148.99	161.40	160.07
General Div.	95.33	94.66	--	--	--	--

Exhibit 10. A comparison of recent sludge management costs expressed in dollars per dry ton. The unit cost of air-drying is increasing more rapidly than the cost of thermal drying. *Source: MWRD annual budgets.*

Sludge management cost data in Exhibit 10 is extracted from the performance data on pages in various MWRD annual budgets. *Solids utilization* is the current practice using lagoons and air drying to produce wet biosolids that is disposed on agricultural and urban land. *Pelletizer disposal* is the thermal drying plant operated by a MWRD contractor. Contractor costs and revenues are not included. In 2019 and 2020, solids utilization was under the General Division of the M&O Department. In 2021 and years thereafter, solids utilization was and is under the respective plant. There are striking differences in the unit costs for the wet and dry biosolids products. The escalating cost of producing wet biosolids by itself should be cause for concern.

Other Sludge Processing Impacts

The use of lagoons and air-drying also gives rise to greenhouse gasses and odors. The MWRD Climate Action Plan includes reference to greenhouse gases, but makes no estimate of same from these sources. Princeton University has been placed under contract to monitor for and quantify greenhouse gases. Transportation of centrifuge cake and wet biosolids causes diesel emissions, but MWRD does not account for these, assigning these emissions to a regional allowance.

Odors are monitored and reported annually as shown on Exhibit 11. Odor monitoring is conducted by MWRD employees at designated sites. The employees sniff the air and assign the odor to one of four categories: (1) very strong odors, (2) strong odors, (3) easily noticeable

Year	Percent of Observations		Number of Observations
	Very Strong Odors	Strong Odors	
Calumet Water Reclamation Plant Sludge Drying Sites, located east and west of the plant at 400 East 130th Street, Chicago			
2009	0	0.3	1,736
2010	0	1.0	1,743
2011	0	3.1	1,482
2012	0.09	2.2	1,156
2013	0	2.3	858
2014	0	1.6	507
2015	0	0.9	679
2016	0	0.3	884
2017	0	0.1	808
2018	0	0.9	684
2019	0.3	0.6	360
2020	1.9	3.0	370
2021	0.8	3.1	779
2022	0.8	3.2	499
Harlem Avenue and Lawndale Avenue Sludge Drying/Processing Sites, located in Bedford Park, Justice, Lyons, Summit and Willow Springs along the Sanitary & Ship Canal			
2009	0	0.8	2,129
2010	0.09	1.8	2,099
2011	0.04	2.8	2,236
2012	0.06	3.7	1,580
2013	0	1.5	1,236
2014	0.2	1.5	549
2015	0.4	1.9	519
2016	0.7	4.8	608
2017	0	1.3	928
2018	0.1	1.4	759
2019	2.4	6.1	165
2020	1.9	3.2	370
2021	0.6	5.5	713
2022	0.9	5.1	743

Exhibit 11. Odors at MWRD air-drying and lagoon sites. One percent is equivalent to 3.65 days each year. *Prepared by the author from data contained in MWRD Monitoring and Research Department reports available on the MWRD website.*

odors, and (4) insignificant odors. The fourth category includes odors which are judged to be no odor, very faint, or faint. As shown in Exhibit 11, the year with the least very strong and strong odors was 2009, the year with the most very strong and strong odors was 2019.

For the 2020 through 2022 period, the most recent three years for which results are available, there were an average of 17 days per year on which odors were strong or very strong at the Calumet plant lagoons and drying areas, and 20 days per year for the Stickney plant lagoons and drying areas. Oddly, MWRD does not appear to receive odor complaints from the public. Either the odors have a short life and don't travel far, or the public has developed OCF, *odor complaint fatigue*.

PFAS is widely known as the acronym for a family of persistent life-threatening chemicals, per- and polyfluoroalkyl substances. PFAS are a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water. After several decades and lawsuits, manufacturers of PFAS chemicals are beginning to discontinue their manufacture. However, their use for several years in consumer goods has made PFAS ubiquitous in the environment. Needless to say, PFAS are also found in sludge.

MWRD also made a compost product using centrifuge cake and wood chips. Composted biosolids was made available to the public at several MWRD plants where it could be carried away at no cost for home gardens. Due to adverse publicity about the dangers of PFAS in a Chicago newspaper in June 2023, MWRD prudently suspended the distribution of composted biosolids. However, there has been no plan to curtail the distribution of wet biosolids to Illinois farmland. Although MWRD believes that wet biosolids containing PFAS is not an environmental or public health threat due to low concentrations of PFAS, it can be argued that continual application to farmland over a period of years causes a buildup in soil and groundwater.

Despite its higher cost, greenhouse gases, odors, and PFAS, MWRD appears committed to continue the practice of land application of wet biosolids. The MWRD Board of Commissioners could establish a policy and/or set a goal to end the application of wet biosolids to Illinois land, but the board appears not to care about the cost, climate, environmental, and health impacts.

The wet biosolids product is sometimes referred to as *exceptional quality biosolids*. The exceptional quality label is based on compliance with regulated compounds. However, the wet biosolids product contains numerous unregulated, life-threatening, and persistent chemicals. Even at nano-levels, these contaminants build up over time, eventually causing land and water pollution. Knowing this, the MWRD should act to demonstrate environmental leadership and protect human and environmental health.

MWRD Sludge Management Future

As this is written, MWRD may be reviewing consultant proposals to study and recommend the future for Stickney plant sludge and biosolids management. If a consulting contract is awarded, what will be the outcome? The consultant may buy into the MWRD practice and recommend continuing with lagoons, air-drying, and land application. Alternatively, the consultant may

recommend a newer technology, like pyrolysis, which is costly and has not been proven on the scale of MWRD operations.

What about the future of Calumet plant sludge? MWRD can do without a consultant because they have experience with thermal drying, a widely used and proven technology. A request for proposals can be advertised for an innovative approach at both the Calumet and Stickney plants, incorporating climate action goals, achieving energy efficiency, sourcing renewable energy or fuels, recovering waste heat, and producing renewable energy.

At both plants, eliminating the use of lagoons and air-drying will free up the land area used for these processes, and provide opportunities for increased energy efficiency and/or revenue.

Currently, the contents of the McCook and Thornton Reservoirs are given complete secondary treatment at the Stickney and Calumet plant, respectively. Aeration in the secondary process requires a vast amount of energy to operate blowers at each plant. Removing the return flow from the two reservoirs would be a significant savings in energy. This can be accomplished by installing wet weather treatment facilities adjacent to the Calumet TARP Pumping Station where the west drying area is located, and adjacent to the McCook Reservoir where the lagoons and drying areas are located. Wet weather treatment only requires preliminary treatment and disinfection.

Another opportunity is the availability of MWRD land available for commercial leasing or conservation purposes. The lagoons at the Calumet plant are known for providing habitat for migrating birds. Community gardening is becoming more popular as the public enjoys growing their own food and obtaining their food from local sources.

Will MWRD take a bold step or will inertia hold them back?