CHESAPEAKE ENVIRONMENTAL PROTECTION ASSOCIATION, INC.
P.O. Box 117, Galesville, Maryland 20765

NEWSLETTER Fall 2016

CEPA FORUM

THE UNSUSTAINABLE SPIRAL OF GROWTH

Anne Arundel Community College, Center for Applied Learning and Technology (CALT) Room 100, Friday, October 14, 2016 7-9 PM

SPEAKERS: Dr. Gerrit Knaap, University of Maryland, National Center for Smart Growth Research and Education

Dr. Elliott Campbell, Maryland Department of Natural Resources, Chesapeake and Coastal Services

Kimberly Brandt, Local Policy Director, 1000 Friends of Maryland

A panel discussion will follow the presentations moderated by Terence Smith

The Chesapeake region has experienced explosive growth since World War II.

- Increases in population and employment foster an expanded local economy. But, taxes and fees do not recover the cost of building infrastructure and services or their maintenance and eventual replacement. When those costs are realized local governments often look to additional new growth for revenues.
- Growth results in consumption of natural resources including productive farm land, clean water, animal habitat, forest, and open space.
- When revenues are not adequate to meet the total costs of growth, the burden is distributed to all residents in the form of additional payments, inadequate services, congested roads and deteriorating quality of life.

This self-driven spiral of growth is detrimental to all residents and is unsustainable.

CEPA has assembled a panel of experts to discuss growth in the Chesapeake region including true costs, planning and financing methods, performance assessment, and some recent successes.

Co-sponsors: The Environmental Center at Anne Arundel Community College; Growth Action network; Maryland League of Conservation Voters, Anne Arundel Chapter; 1000 Friends of Maryland

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PRESIDENT'S MESSAGE

By Al Tucker

Hopefully, you will be able to attend our 2016 Forum on the "Unsustainable Spiral of Growth." As I mentioned in a previous newsletter (Winter 2016), attempting to limit population growth in the Bay region will become a more difficult task as the national economy improves. The environmental impact of an additional person not only subtracts from the passive natural ecosystem services provided by open space, forests and wetlands, but it also adds to infrastructure services and costs that local governments must actively provide. In exurban counties, like Anne Arundel and those in Southern MD, that leads to more traffic, larger wastewater treatment plants with enhanced nutrient removal technology, higher rates of conversion of agricultural land, forests and wetlands to "sprawl," and to adverse fiscal impacts when tax revenues are insufficient to cover the long term hidden costs of providing public services.

Since these concerns transcend more than CEPA's environmental issues, we have partnered with other organizations (Growth Action Network, League of Conservation Voters, 1000 Friends of MD, and The Environmental Center at Anne Arundel Community College) to present a more balanced discussion of the problems caused by GROWTH in the exurban counties.

The problems fall into three main categories:

- Fiscal - the ability to pay for current infrastructure maintenance and its replacement
- Environmental/Social - the loss of ecosystem services caused by low-density land-use and the subsequent impact on "quality-of-life."
- Political - the lack of political will to adequately address the above issues.

Modern society depends critically on its infrastructure to promote well-being and the quality-of-life that we have come to expect. We take for granted that the air we breathe is pure, that the water we drink is clean, that our waste and detritus is disposed of sanitarily, that the energy that allows us freedom of movement are all available without consequences. More than two centuries ago, all these basic services were provided by our ecosystems. In modern society, what was provided naturally now must be provided with man-made services that have long-term recurring costs for maintenance and replacement. Water delivery systems, wastewater treatment plants, streets and highways basic to our way of life must be maintained, repaired and renewed at the end of their lifetimes. This leads to the fundamental question: Are local governments adequately planning, conserving our remaining ecosystem services, and funding current and future infrastructure to accommodate future growth?

The fiscal issues actually supersede the environmental issues. In the exurban counties, low-density residential sprawl predominates. The high fixed cost of infrastructure means that higher density development spreads the cost over more residents and lowers per resident costs. However, study after study has shown that even tax revenue from these properties is insufficient to cover the cost of maintenance and replacement. This discrepancy creates an unsustainable spiral as new development creates new infrastructure that must be maintained and eventually replaced. Some counties charge impact fees that must be spent on new infrastructure to support new development. While this may appear to be "free" to taxpayers (since the cost is borne by the new residents), future costs must be borne by all taxpayers when the infrastructure needs to be replaced. Some counties do not even cover all the up-front costs. Anne Arundel, for example, charges only 80%, of the estimated costs. Even Adequate Public Facilities Ordinances which should provide a relief for excess growth contain loopholes that only delay growth at best. In Anne Arundel County, a developer need only wait 6 years to proceed if the infrastructure is not in place. As a result, development is driven by the economic priorities of developers, not the well-being of residents who have to bear the future costs of the added infrastructure.

What has happened to our environment and social well-being in the meantime? Between 1970 and 1994, under the prevailing low-density trends in development, the Chesapeake Bay area population grew by 26 percent while vehicle miles travelled increased by 105 percent. Now vehicles contribute more than one third of the nitrogen deposition to the Bay watershed. Additionally, the census records that county residents are experiencing longer and longer commuting times. Longer travel times take away from family and recreational times, which studies have shown impact health adversely. Also, stormwater and wastewater utility fees give us the impression that nitrogen is being removed; yet air pollution continues to deposit nitrogen directly on the Bay. More automobiles require more roads just to maintain a level of service. Yet, experience shows that the pent-up demand causes the improvement to be only temporary. Not only does nitrogen pollution increase with more autos, the area they cover increases the county's impervious surface by a factor of four. This leads to more stormwater run-off. This example is but one of many to illustrate the unintended consequences of pursuing low-density development. One could go on and on with even this example, but I think you get the picture.

Thus, current policies that encourage low-density, auto-centric growth are perversely creating a false impression that all is well. It is time for change. The current General Development Plan for Anne Arundel County is due for revision in 2019. Now is the time for citizens to prepare themselves with as much information as they can gather to address these issues. Processes and policies need changing. It can be done; the recent success in Charles County show that citizens can make a change. There a coalition of like-minded organizations[1] achieved the following:

- **Saved** 88,000 acres of Maryland Department of Natural Resources' GreenPrint Targeted Ecological Areas from rural development
- **Stopped** an estimated 339 major residential subdivisions on highly polluting septic systems in GreenPrint areas
- **Prevented** an estimated 123 major new subdivisions from being built in nine MDE-designated High Quality Watersheds
- **Protected** the headwaters of the Port Tobacco River, the Mattawoman stream valley and much of the Mattawoman watershed with a new Watershed Conservation District designation
- **Expanded** the Priority Preservation Area, initially limited to farmland, to include forestland in western Charles County

IN THIS ISSUE

- **Prevented** the expenditure of an estimated $2 billion on new road construction and future maintenance by the public and private sectors.
- **Focused** development in the County's existing Priority Funding Areas
- **Reduced** the sprawling Development District from 52,220 acres to 22,189 acres
- **Cut** the projected population growth rate in half to 1%

Please join us on October 14th, 7 pm, at the Anne Arundel Community College. The Forum will feature land-use planning and development, including a lively panel discussion moderated by Terry Smith on this important topic.

UNFETTERED DEVELOPMENT AT ANY COST MUST BE STOPPED

[1]Charles County Victory: Smart Growth = Pollution Prevention, 8/2016 http://www.friendsofmd.org/images/PDFReportsAndPublications/Charles%20County%20victory%20%20Pollution%20prevention%208.7.16.pdf

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EFFECT OF PLASTICS ON MARINE WILDLIFE

By Gary Antonides

In our last newsletter, we discussed the magnitude of plastic pollution in our oceans, how it accumulates in certain locations, how it breaks down into microplastics over time, as well as some of the methods of controlling the flow of plastics into our oceans. In this article, we discuss the effects of plastics in our oceans on marine wildlife.

Large Pieces -- It is easy to see how larger pieces of plastic can damage wildlife. The photos show three examples. The effects of plastic rings on the turtle and seal are obvious. The corpse of the albatross chick is an example of marine life eating plastics. Midway Atoll is one of the places where plastic debris accumulates. Thousands of bird corpses rest on these beaches, piles of colorful plastic remaining where their stomachs had been. It is estimated that of the 1.5 million Laysan Albatrosses which inhabit Midway, all of them have plastic in their digestive system. For one third of the chicks, the plastic blockage is deadly. Captain Charles Moore, researcher and author of "Plastic Ocean" saw albatrosses and tropical birds circling above a line of trash, and choosing the reds and pinks and browns - anything that looks like shrimp.

Greenpeace reported that a staggering 80 percent of seabird populations observed worldwide have ingested plastics. Research into the stomach contents of dead Fulmars from the Netherlands, between 1982 and 2001, found that 96 percent of the birds had plastic fragments in their stomachs with an average of 23 plastic pieces per bird (Van Franeker and Meijboom, 2003). When plastic ingestion occurs, it blocks the digestive tract, gets lodged in animal's windpipes cutting airflow and causing suffocation, or fills the stomach, resulting in malnutrition, starvation and often death.

In a 2006 report, *Plastic Debris in the World's Oceans*, Greenpeace stated that at least 267 different animal species are known to have suffered from entanglement and ingestion of plastic debris. The National Oceanographic and Atmospheric Administration said that plastic debris kills an estimated 100,000 marine mammals annually, and millions of birds and fishes. From 50 to 80 percent of sea turtles found dead are known to have ingested plastic marine debris.

In April 2002 a dead Minke whale washed up on the Normandy coast in France. Its stomach contained 800 kg of plastic bags (GECC, Groupe d'Etude des Cétacés du Cotentin, 2002). In February 2004, a Cuviers Beaked whale (Ziphius cavirostris) was found washed ashore on the west coast of the Isle of Mull, Scotland. The Scottish Agricultural College found that the entrance to the stomach was completely blocked with tightly packed shredded black plastic bin liner bags and fishing twine.

Of the 260 million tons of plastic the world produces each year, about 10 percent ends up in the Ocean, according to a Greenpeace report (Plastic Debris in the World's Oceans,

2006). Much of it eventually sinks, damaging life on the seabed. The rest floats in open seas, often ending up in gyres, circular motion of currents, forming conglomerations of swirling plastic trash called garbage patches, or ultimately ending up washed ashore on someone's beach. Plastics travel long distances. Their distribution in the oceans isn't uniform, yet they are omnipresent from the Polar Regions to the Equator.

The largest pieces of marine debris, mostly miles long discarded fishing nets and lines, take an obvious toll on animals. These derelicts nets, called ghost nets, snare and drown thousands of larger sea creatures per year, such as seals, sea lions, dolphins, sea turtles, sharks, dugongs, crocodiles, seabirds, crabs, and other creatures. These nets restrict movement causing starvation, laceration, infection, and, in animals that need to return to the surface to breathe, suffocation. Derelict fishing gear can also be destructive to coral reefs. Nets and lines become snagged on coral and subsequent wave action causes coral heads to break off. Plastic bags kill coral by covering them, or by blocking sunlight.

Plastic bags are dangerous because they can be mistaken for food and consumed by a wide range of marine species, especially those that consume jellyfish or squid, which look similar. Various governments including those of San Francisco, China, Ireland, Uganda, South Africa, Russia, and Hong Kong have banned plastic bags. In the U.S. measures to ban or curtail the use of plastic bags have met with official resistance. The plastics industry argues that jobs will disappear.

In many areas where marine debris concentrates, so does marine life. This makes simple scooping up of the plastic risky and more harm than good may be caused. Straining ocean waters for plastics would capture the plankton that is the base of the marine food web and responsible for 50 percent of the photosynthesis on Earth. (NOAA). Captain Charles Moore says cleaning up of the oceanic garbage patches "would bankrupt any country and kill wildlife in the nets as it went." However, Doug Woodring, from Project Kaisei, will be producing a documentary for National Geographic testing catch techniques for the plastic, at least for the largest debris.

Micro- and Nano-Plastics -- Micro- and nanoplastics are new categories of plastic litter that wastewater treatment facilities in the most developed countries are not yet equipped for. From toothpastes and deodorants to shower gels, eye shadow and sunscreen, numerous products have contained tiny plastic particles for decades.. They deliver active ingredients, exfoliate, regulate viscosity and fulfill numerous other functions. Some products are made up of 90 percent of these tiny plastic grains. They are so small their size is described in micrometers (thousandths of a millimeter). A human hair is around 100 micrometers thick. Some producers even use tinier particles, nanoplastics, which are in the range of millionths of millimeters. How many of these particles reach rivers and streams, and eventually the ocean, is unknown.

The biggest source of microplastics, however, is larger items breaking down. Every piece of plastic in the ocean falls apart with time. Ultraviolet light and the force of the waves degrade fishnets, plastic bags, bottles, and toothbrushes into smaller and smaller pieces. These are likely to dwarf the amount coming from cosmetic products or textiles, a recent study by the Federal Environment Agency of Germany suggests. Little is known about the impacts of micro-plastics on a wide range of smaller organisms, including the effects of chemicals in the plastics. The particles mimic food items for zooplankton and small fish, and to some degree, they will move up the food chain. But there is also damage to the guts of small critters. (http://www.greenfacts.org/en/marine-litter/l-2/3-micro-plastics.htm).

At the Alfred Wegener Institute in Germany, a research team has conducted a study to find out how much plastic escapes wastewater treatment plants. They found that substantial amounts of microplastics get into their rivers, but also that the amounts from different facilities vary greatly. To detect micro- and nanoplastics and hold them back completely in a wastewater treatment plant requires an additional stage of cleaning, which would increase costs to consumers.

Lars Grønbæk is a process engineer working for the Danish wastewater purification company KD, and is a specialist in membranes that can remove tiny particles from water using a principle similar to a coffee filter. His company's membranes are already capable of filtering down to a size of a tenth of a micron, and they could be further refined. But at the moment, only a small fraction of wastewater treatment plants are deploying membrane filters, says Grønbæk. As long as there is no regulation requiring them to do so, this is unlikely to change.

Of course, if we did not use materials that can become a problem for the environment, we would not have to remove them with expensive technologies. Accordingly, in late 2015, President Obama signed the Microbead-Free Waters Act, which bans tiny plastics in cosmetics and other products.

Some emerging economies are growing so fast that their waste management systems can't keep up, and so their contribution to marine debris is enormous. If just five countries — China, Indonesia, Vietnam, Thailand and the Philippines — improved their recycling and waste disposal systems, they could cut global inputs by almost half, according to http://www.oceanconservancy.org/our-work/marine-debris/mckinsey-report-files/full-report-stemming-the.pdf.

Materials can degrade by photodegradation or biodegradation. Plastics are generally a durable material and resistant to natural biodegradation because the microbes that break down other substances do not recognize plastic as food. Yet plastic can be fragmented with the effects of UV, being broken down by light in smaller and smaller debris over time, which is photodegradation. This process continues down to the molecular level, yet photo-degraded plastic remains a polymer. No matter how small the pieces, they are still plastic and are not easily absorbed into or changed by natural processes.

Dr. Richard Thompson of the University of Plymouth, UK has found plastic particles thinner than the diameter of a human hair in filter feeders like mussels, barnacles, and amphipods. The photo degradation of plastic makes matters worse since it is eaten by tinier marine organisms, therefore entering the food chain earlier and ultimately affecting more marine life.

Marine biologist David Barnes of the British Antarctic Survey says plastics can actually change entire ecosystems. He has documented that floating plastic debris acts as rafts for small sea creatures to grow and travel on. This represents a potential threat should an alien species become established.

Chemical Effects -- Plastics in the ocean can damage wildlife chemically in two ways. They can leach problematic additives such as bisphenol A, and they also show a tendency to absorb organic pollutants such as DDT from the water around them, acting like pollution sponges, which, as bits of plastic are eaten, results in toxins accumulating up the food chain.

Until recently, it was thought that plastic rubbish is relatively stable chemically and, its principle threat to living creatures came from its ability to choke or strangle animals that either got caught in it or ingested it thinking it was food. However, a 2009 report by Katsuhiko Saido at Nihon University in Chiba,

Japan, has found that at least Styrofoam degrades more rapidly than previously thought in the conditions and temperatures of the open ocean, and that as plastics break down in the sea they release toxic substances not found in nature and which could affect the growth and development of marine organisms. They release a range of chemicals, including bisphenol A, which has been implicated in disrupting the hormonal system of animals.

All sea creatures, from the largest to microscopic organisms, are, at times, swallowing the seawater soup instilled with toxic chemicals from plastic decomposition. Humans are eating fish that have eaten other fish, which have eaten toxin-saturated plastics. In essence, we are eating our own trash.

Marine litter used to be primarily organic materials, but is now 60 to 80 percent plastic, according to a report published in October 2008 in *Environmental Research*. In addition, most of these plastic waste items are highly buoyant, allowing them to travel in currents for thousands of miles.

Some common plastics that leach chemicals are: polyvinyl chloride (called one of the most hazardous consumer products ever created), polystyrene, and polycarbonate. These are associated with endocrine disruption, chromosome damage, adverse effects on red blood cells, the brain, nervous system, sexual function, behavior, liver, kidneys, and stomach, as observed either in humans or in animal studies.

Dioxins are produced during the manufacture of materials containing chlorine, including PVC, as well as other industrial processes. Although emission controls keep much of it from entering the environment, it is still a major pollution problem. Dioxin is the most potent synthetic carcinogen ever tested in laboratory animals. The National Institute of Standards and Technology says it is over 10,000 times more potent in causing cancer than the next highest chemical. http://oceanbites.org/model-suggests-40-of-global-dioxin-emissions-end-up-in-the-oceans/ reports on a model study that indicates that 40% of all dioxin emissions end up in the ocean.

There are safer plastics. High-density polyethylene (HDPE), Low-density polyethylene (LDPE), and Polypropylene (PP) are safer. Biodegradable bio-based plastics, made from resources such as corn or potato starch and sugar cane, are also safer.

The concentration of absorbed chemicals like PCB's and DDT in plastics can be almost 1 million times greater than the overall concentration of the chemicals in seawater. This makes plastic far more deadly in the ocean than it would be on land. These findings were published in the *Marine Pollution Bulletin*. PCBs can lead to reproductive disorders, death, and the alteration of hormone levels. They have been linked to the masculinization of female polar bears and spontaneous abortions and declines in seal populations.

Solutions -- Nonprofits are addressing plastic pollution, and governments at the local and federal levels, as well as many countries, are passing laws to help solve the problem of plastics in the ocean. They usually involve education and advocate the three "r's" -- reduce, recycle, and reuse.

Biodegradable Plastics -- According to the Biodegradable Plastics Society (2005), when these are composted they break down to carbon dioxide and water. Controversy exists though, because it is possible that they do not break down fully and leave non-degradable constituents, some of which may be hazardous. Scientists at the University of Southern Mississippi (USM), with funding from the Naval Sea Systems Command (NAVSEA), are developing a new type of plastic that degrades into nontoxic products in seawater. It is made of polyurethane that has been modified by the incorporation a known degradable polymer used in surgical sutures.

Microorganisms -- In 2008 a high school student, Daniel Burd, discovered plastic-consuming microorganisms. He immersed ground plastic in a yeast solution that encourages microbial growth, then isolated the most productive organisms. After six weeks of tweaking and optimizing temperatures, he achieved a 43 percent degradation, an amazing feat -- a non-chemical, fully organic, low cost, nontoxic method for degrading plastic. There have been other bacteria or fungus based solutions developed in Japan, Ireland, and Wisconsin.

A new kind of material, called oxo-biodegradable plastic, does not just fragment, but is subsequently consumed by microorganisms. This process continues until the material has biodegraded to CO2, water, humus, and trace elements. It can be made with the same machinery and workforce as conventional plastic. The time taken to degrade can be programmed to a few months or years and, until it degrades, it has the same characteristics as conventional plastic.

http://news.discovery.com/earth/oceans/plastic-eating-microbes-help-marine-debris-sink-140619.htm reports on a 2014 study that indicates that microscopic creatures may be helping to reduce marine garbage in the ocean surface. Oceanographers at the University of Western Australia found that microscopic creatures appear to be biodegrading the millions of tons of debris floating on waters worldwide. The study documents the biological communities living on tiny particles of microplastics, and records many new types of microbe and invertebrates. While there has been research on microbes eating plastic at landfills, this shows that their marine counterparts could be just as effective on ocean garbage. The actions of the microbes could explain why the amount of plastic floating on the seas has not been expanding as fast as expected.

ENERGY STORAGE
by Rich Romer

Energy Storage is the capture of energy produced at one time for use at a later time. Energy comes in multiple forms including radiation, chemical, gravitational potential, electrical potential, electricity, elevated temperature, latent heat and kinetic. Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms. Bulk energy storage is dominated by pumped hydro, which accounts for 99% of global energy storage. In the recent past, fossil fuels—coal, oil, and gas--have been the predominant source of energy production through their conversion to heat to power electrical generation. Atomic energy appeared at one time to be a promising replacement source of energy generation and storage but safety concerns, exacerbated by accidents at Three Mile Island, Pennsylvania, and Chernobyl, Russia, and the challenge of safely moving and disposing of spent nuclear fuel have resulted in a visceral reluctance to expand the application of this technology to the production of electricity.

In the twentieth century grid electrical power was largely generated from fossil fuel. When less power was required, less fuel was burned. Concerns with air pollution and global warming have since spawned the growth of intermittent

renewable energy such as solar and wind power. Being intermittent, they could be generating at a time when no additional power is needed, hence the interest in storing it.

Off grid electrical use was a niche market in the twentieth century, but in the twenty first century it has expanded. Portable devices are in use all over the world. Solar panels are now a common sight in the rural settings worldwide. Access to electricity is now a question of economics, not location. Powering transportation without burning fuel, however, remains in development with rapidly growing interest.

Without going into detail, the existing technologies for the storage of energy are listed to illustrate the large number of possibilities for future development and application.

Mechanical
- Compressed air energy storage (CAES)
- Fireless locomotive
- Flywheel energy storage
- Gravitational potential energy (device)
- Hydraulic accumulator
- Liquid nitrogen
- Pumped-storage hydroelectricity

Electrical
- Capacitor
- Superconducting magnetic energy storage (SMES)

Biological
- Glycogen
- Starch

Electrochemical
- Flow battery
- Rechargeable battery
- Supercapacitor
- UltraBattery

Thermal
- Brick storage heater
- Cryogenic liquid air or nitrogen
- Eutectic system
- Ice Storage
- Molten salt
- Phase Change Material
- Seasonal thermal energy storage
- Solar pond
- Steam accumulator
- Thermal energy storage (general)

Chemical
- Biofuels
- Hydrated salts
- Hydrogen
- Hydrogen peroxide
- Power to gas
- Vanadium pentoxide

The increased interest in electrically powered motor vehicles has incentivized a dramatically growing interest in increasingly efficient energy storage. Japanese and American manufacturers are producing and selling growing numbers of totally electric and hybrid powered vehicles. CEPA's President is one of the early owners of a Toyota Prius hybrid car. Silicon Valley entrepreneur Elon Musk has created a new market segment with his totally electric Tesla cars and is investing heavily in a new evolution of energy storage for mobile, commercial and residential applications.

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