National EPA-Tribal Science Council (TSC)
Winter 2018 Face-to-Face Meeting

U.S. Environmental Protection Agency (EPA)
Gulf Ecology Division (GED) Laboratory
1 Sabine Drive
Gulf Breeze, Florida

December 4, 2018

MEETING SUMMARY

Welcome, Introductions, Roll Call and Invocation
José Zambrana, TSC Agency Co-Chair, EPA Office of Research and Development (ORD); Rick DuBois, TSC Tribal Vice Chair, Seneca-Cayuga Nation; Bruce Rodan, Associate Director for Science, EPA ORD; and Neil Patterson, Jr., Tuscarora Nation

José Zambrana, Rick DuBois and David Jewett welcomed the participants to the meeting, and the participants introduced themselves. Neil Patterson, Jr. provided the opening blessing. Rick D. thanked the GED staff for their efforts in hosting the meeting and the TSC's Agenda Development Team for developing a robust agenda. Next, he described the revised and condensed agenda.

Bruce Rodan thanked the TSC members for meeting at the Gulf Breeze facility, noting the serious work that the TSC has accomplished during its 17 years of existence. ORD is in the process of planning its research for the next several years and is engaging tribes to ensure that tribal science and research needs are addressed in ORD's six Strategic Research Action Plans (StRAPs). The next step will be for ORD to conduct formal consultation about the StRAPs. Bruce finished his opening remarks with a personal anecdote about working on the issue of declining numbers of pollinators in a previous job and how the team recognized that tribal input was needed to address the problem holistically. Viewing issues through a cultural framework often is necessary, and he is happy to be involved with the TSC.

Overview of GED
Elizabeth George, Director of GED, EPA ORD National Health and Environmental Effects Research Laboratory

Elizabeth George provided some of the history of Sabine Island, a manmade island created by ballast dumping between 1876 and 1903. From 1906 to 1936, the island served as a quarantine station, and then from 1936 as an oyster and fisheries research laboratory until it became an EPA laboratory in 1970. Most of the buildings are former residences. The GED at Gulf Breeze provides leadership in marine, estuarine, and watershed ecology and ecotoxicology to predict and assess the effects of human-generated stressors on the unique aquatic resources of the U.S. portion of the Gulf of Mexico. Scientists work closely with communities, states and regions to develop tools and provide a scientific basis for environmental management decision making that maximizes economic, ecosystem and social outcomes. The facility is uniquely capable of addressing environmental challenges of Gulf coastal ecosystems. Research focus areas include nutrients and hypoxia, water and watershed protection, predictive ecotoxicology, ecological assessment and services, and community sustainability.

GED research is divided into three categories: water quality, sustainability, response and recovery; ecological chemical risk assessment; and resilient and sustainable communities. The goal of the water quality, sustainability, response and recovery research area is to quantify the effects of anthropogenic stressors on coastal and marine water quality and ecosystem health endpoints using observational and

modeling approaches. This research has produced essential scientific information and innovative tools that result in higher confidence water resources risk assessments that support regulatory decision making and policy development, as well as water-quality management decisions for the long term. The goal of the ecological chemical risk assessment research area is to develop approaches using computational chemistry, molecular endpoints and predictive modeling that improve evaluation of hazard and risks of environmental chemicals to ecological receptors and ecosystems. The research has resulted in improved toxicity estimation of amphibian developmental effects for ecological risk assessment and has minimized harmful effects to listed species from pesticide exposure, providing greater protection of other species. The goals of the resilient and sustainable communities research are to (1) develop approaches using stakeholder partnerships that address real-world issues and promote sustainable ecosystem management while informing community planning decisions and (2) connect the benefits of nature directly to human well-being using models, spatial data analysis and indicator frameworks to support sustainable decision making at the community level. The research has resulted in the development of decision-support tools and approaches that, when combined with acceptance of their value through local partnerships, will greatly improve the outcome of complex decisions in terms of resource sustainability and human well-being.

Karen Hamernik asked what percentage of the research is modeling, computational or systematic. Yongshan Wan, a GED scientist involved with modeling projects, described several different models developed by GED, including a large-scale process phase model that links Gulf of Mexico water quality to estuarine response and models that focus on human well-being. He estimated that approximately 50 percent of GED Gulf Breeze's work is based on modeling. Lee Juan Tyler noted that tribes in the Pacific Northwest need modeling to help them address various issues related to salmon.

TSC Tribal Caucus Self-Introductions and Tribal Vignettes
Neil Patterson, Jr., Tuscarora Nation; Rick DuBois, Seneca-Cayuga Nation; Page Hingst, Santee Sioux Nation of Nebraska; Joshua Tweeton, Spirit Lake Tribe; and Lee Juan Tyler, Shoshone-Bannock Tribes

Each TSC Tribal Caucus member gave a brief presentation about his or her tribe's background, history and tribal science needs.

Neil (Region 2) explained that Region 2, which includes states in the northeastern United States, Puerto Rico and the U.S. Virgin Islands, is one of the most culturally and politically diverse EPA regions. Three of the tribes in New York—including Neil's tribe, the Tuscarora Nation—have never adopted a written constitution, and the governments have remained the same since time immemorial. Haudenosaunee women are responsible for removing tribal chiefs when necessary. Some federal agencies find the Haudenosaunee governments challenging to work with because of their structures. For example, the Tuscarora Nation has no relationship with the Bureau of Indian Affairs (BIA). Most of the tribes in New York are Haudenosaunee and reside in upstate New York, with the exception of two Algonquin nations that inhabit Long Island. Neil's tribe deals with rural and land-rights issues, as well as issues introduced because of actions that occur off of tribal lands. Because the tribe resides in the United States and Canada, many issues are transnational, and the tribe meets with the federal governments of both countries. Hundreds of thousands of acres of tribal land were stolen by the state of New York, and the Tuscarora Nation's land claims are in litigation in the world court. The tribes have a close-knit assemblage of peoples under the Haudenosaunee with a diverse set of governances. Neil encouraged EPA and state employees to seek cultural sensitivity training.

Rick D. (Region 6) explained that he is a member of the Cherokee Nation of Oklahoma and works for the Seneca-Cayuga Nation, which is one of three federally recognized tribes of the Seneca people. The Seneca and Cayuga were two of the five tribes of the Iroquois Confederacy (Haudenosaunee) in present-day New York state and voluntarily emigrated to Ohio in response to European colonization before being

forcibly removed to "Indian Territory" (present-day Oklahoma). The Seneca-Cayuga Nation is located in the northeast corner of Oklahoma alongside eight other tribes and has a "jurisdictional boundary" rather than a reservation as a result of the Dawes Act of 1887. Of the tribe's 5,059 enrolled members, 1,174 live within the boundary area (referred to by the tribe as "on the boundary"). The tribe prides itself on being a traditional tribe that has kept its original ceremonies intact. The boundary is downstream of Tar Creek, the first and largest Superfund site, and the waters are laden with heavy-metal mine discharge. The tribe's Environmental Services programs include water quality monitoring, lead exposure outreach and education, indoor air quality testing, and recycling. Rick D. described the Seneca-Cayuga Nation's science needs:

- Climate change predictive modeling at the regional scale to gauge future effects on surface water and groundwater supplies, as well as culturally significant flora and fauna.
- Additional data and guidance on the health effects of exposure to lead, arsenic and cadmium, particularly through consumption of fish and aquatic plants, as well as direct body contact with water and inhalation of dust.

Page Hingst (Region 7) explained that the Santee Sioux Nation—the Dakota-speaking band of the Great Sioux Nation—comprises 116,000 acres in northeast Nebraska along the Missouri River, including the village of Santee, which has approximately 300 community members. The Santee Sioux people originally lived in Minnesota, and following a breach of an 1837 treaty that led to famine conditions, two Santee Sioux warriors led the Santee Uprising. As a result, 1,800 tribal members were imprisoned, and 38 were executed. The tribe's Office of Environmental Protection's air concerns include indoor air quality, radon, smoke management and pollution source identification in the emissions inventory. One of the office's water concerns is the very high level of *Escherichia coli* found in the area. Nonpoint sources (agriculture runoff, high nitrates) also are of concern. The Santee Sioux Nation Tribal Response Program deals with illegal dumping and littering at 33 dump sites and is concerned about the connection between water impairment and the illegal dump sites, possible per- and poly-fluoroalkyl substance (PFAS) contamination, and other potential contamination. A newly implemented solid waste management program has resulted in the collection of 22.3 tons of solid waste thus far. During the fall of 2018, the tribe also partnered with BIA to clean up six illegal dump sites, ultimately collecting 141 tons of solid waste. The tribe's overarching science concerns are related to enforcement, community buy-in and technical guidance.

Joshua Tweeton (Region 8) explained that the Spirit Lake Tribe has 7,256 enrolled members, 2,069 of whom live on the Spirit Lake Reservation. The 405-square-mile reservation, located in east central North Dakota, was established by a treaty between the U.S. government and the Sisseton Wahpeton Sioux Bands in 1867. The boundaries described in the treaty are based on the boundaries of Devil's Lake and the Sheyenne River, which have changed over time, creating jurisdictional issues. Levees have caused flooding of what used to be reservation land, and the state has claimed jurisdiction over these areas. Many of the roads on the reservation are under water, and many had to be built up 30 to 50 feet to remain above water. The tribe's casino now is located on an island. The major surface water body is the Sheyenne River, which forms the southern boundary of the reservation. Devil's Lake discharges into the Sheyenne River, and numerous small streams and springs within the reservation also contribute flows to the river. In addition, the rivers and streams of the reservation have substantial areas of associated lakes, wetlands and prairie potholes. A proposed hog farm near Devil's Lake threatens the water and environment within the reservation. The tribe has received a Brownsfield grant to clean up contaminated buildings in one of the reservation's housing areas and address the tribe's ongoing housing shortage. The tribe's science needs include technical assistance on a variety of issues, legal defensibility and quality assurance.

Lee Juan (Region 10) explained that the Shoshone-Bannock Tribes were warrior tribes and originally ranged from Canada to Mexico, as evidenced by the persistence of the original language from Canada

south to Mexico. The reservation in southeast Idaho was established as part of a treaty signed on July 3, 1868, and originally included 1.5 million acres, which has decreased to 544,000 acres following three secessions. An underground aquifer approximately the size of Lake Erie and shaped like a salmon lies underneath the reservation. The tribe owns 99 percent of its lands. Approximately 6,000 tribal members live on the reservation. The tribe had its own "trail of tears" and was almost wiped out by genocide. The tribe continues to fight for off-reservation treaty rights on federal lands. The tribe's science needs are as follow:

- Methods to ensure that tribally generated data are acceptable for use in EPA decision making.
- EPA recognition of the tribe's ethnographic and anthropological data, as well as tribal consumption rates.

GED Research Vignettes With Case Studies and Discussion

Scleractinian Coral Microplastic Ingestion: Potential Calcification Effects, Size Limits and Retention
Cheryl Hankins, EPA ORD

Cheryl Hankins explained that the 12.2 million tons of plastics that enter the global marine environment annually come from a number of sources, including tire dust and industrial processes. Approximately 94 percent of these plastics sink to the ocean floor as sediment. GED researchers investigated microplastic ingestion and its effects on the coral species *Montastraea cavernosa* and *Orbicella faveolata*, the primary reef builders in the Caribbean and Florida Keys. They determined that the corals ingest microbeads, but no significant difference in calcification occurred following ingestion. To test size limits and retention, the two different coral species were exposed to microbeads in four sizes; *M. cavernosa* ingested between 90 to 100 percent of all four sizes, whereas *O. faveolata* ingested nearly all of the two smaller-sized beads but only 20 percent of each of the two larger sizes of beads. Both species released the majority of all beads after 48 hours. When the researchers tested the uptake of microbeads compared with microfibers, they found that both species had 97 to 100 percent uptake of both materials. *M. cavernosa* released 100 percent of both materials after 48 hours, and *O. faveolata* released approximately 80 percent of both types of materials after 48 hours. The researchers concluded that microplastics have no short-term effects on calcification for the two species tested, coral actively ingest microbeads and microfibers, and retention of these materials is short. Future questions to explore include the maximum size limit that corals will ingest, the long-term effects on calcification, and whether the retained microplastics impair digestion. Field work occurred in St. John, U.S. Virgin Islands, in 2017 and in the Florida Keys in 2018, and analysis included quantification and polymer identification. This work was published in the October 2018 issue of *Marine Pollution Bulletin*.

In response to a question from Lee Juan, Cheryl explained that three types of manta rays live in the area around GED.

Science to Inform Development of Thresholds for Nutrient Management
James Hagy, EPA ORD

James Hagy explained that excess nutrients, such as nitrogen and phosphorus, are a pervasive problem that has environmental, economic and social effects. Challenges for environmental agencies dealing with this issue include quantifying the exposure and effects, finding solutions, and communicating the benefits of nutrient management. The objective of GED's efforts in this area is to work with interested partners to identify priorities for protection and find or generate scientific information to inform policy development. Nutrients are present across the entire landscape and enter waterways at a variety of locations, moving downstream and affecting various locations and water bodies differently. These various effects must be considered in nutrient management. An evaluation of case studies in the literature of nutrient management in lakes and estuaries around the world found four characteristics associated with successful nutrient

management. Two of the characteristics are (1) local engagement, leadership and (2) consensus and a strategy that sets numeric targets based on a specific ecological goal.

Because nutrient effects are modulated by a variety of environmental factors, local management of these localized effects is critical. In developing nutrient criteria, decision makers must consider what is important to the people who interact with the water body, what state or tribe has jurisdiction over the water body, and the desired endpoints. Two approaches exist when developing nutrient criteria: the reference condition approach and the response-based approach. In the latter, it is necessary to understand the desired endpoints and their relationship to water-quality conditions and then relate these factors to the drivers. One example of this is the effort to quantify periphyton communities in streams to quantify changes associated with nutrient effects.

Seagrass habitats are ecologically important, have a number of beneficial functions, and are affected by water clarity, which in turn is affected by nutrient load. The researchers examined 100 estuary segments in the state of Florida and used the findings to develop nutrient targets. A molecular approach for indicators of nutrient effects, such as periphyton, is feasible because microbial community shifts could signal more serious, future aquatic life changes. In one study, microbial communities in coastal Alabama streams shifted consistently in response to experimental nutrient additions. These shifts can be used to predict and maintain desirable stream conditions, so the next step is to further develop molecular-based indicators of nutrient effects in streams.

GED provides technical support to a number of states in various EPA regions in terms of modification of dissolved oxygen, chlorophyll-a or other nutrient-related water quality criteria. GED's work has resulted in the creation of analytical frameworks for criteria development. ORD experience meets the needs for technical support and data and model analysis. New bioindicators could help to solve challenges related to stream bioassessment.

Lee Juan asked why GED provided technical support only to the states mentioned in the presentation. James responded that GED supports entities that request technical assistance, but staffing also must be considered. If GED personnel are made aware of a specific situation, they will do their best to provide technical assistance on request.

Lon Kissinger asked whether the researchers could predict red tides and harmful algal blooms (HABs). James replied that the study of HABs is a large, complex field, and nutrients are not the only factor in their development. He is not an expert in this area, but he understands that nutrients affect the various HAB species differently.

National Aquatic Resource Surveys (NARS)
Linda Harwell, EPA ORD

Linda Harwell explained that EPA developed the NARS because the Agency needed to strengthen its ability to report on and effectively address questions about the condition of U.S. water resources after determining that most of the water bodies across the country were not being assessed. The surveys are an ongoing EPA effort to assess the ecological condition of aquatic environments across the United States and over time, using nationally consistent information collected in partnership with states, tribes and federal organizations. The NARS effort is partnership-driven in a truly integrative environment that includes ORD, EPA's Office of Water and regions, and states and tribes; it also provides nationally relevant water-quality assessments that support national priorities. The national measures developed include biological and public health indicators, the occurrence and extent of key stressors, and new indicator research. NARS has allowed substantially increased confidence in EPA's ability to report on U.S. water conditions.

GED provides technical and scientific support for the National Coastal Condition Assessment and National Wetlands Condition Assessment; produced much of the foundational research that informed planning, logistics and implementation of the NARS for coastal and wetland resources; developed and tested many of the indicators used in coastal and wetlands assessments, including reporting style; and developed relationships to demonstrate the strengths of state, tribal and federal partnerships to successfully implement a national aquatic assessment. NARS has increased state monitoring capacity, leveraging the flexibility of the NARS approach to address state and regional needs while also contributing to the national assessments. NARS data also assisted in the Deepwater Horizon oil spill assessment. The surveys also have been adapted to assess coral reef condition.

Moving beyond technical assistance, communication and translation can be addressed by connecting NARS assessment results to community resilience and well-being. Integrating NARS data with existing environmental applications or tools (e.g., Rapid Benefit Indicators, watershed models) provides tools for state partners to help inform and prioritize ecosystem protection and restoration efforts. Developing approaches that integrate state aquatic resource monitoring with NARS can improve assessment scales and/or utility and promote the integration of monitoring data.

Karen H. asked about the integration of pollutants. Linda responded that historically persistent polychlorinated biphenyls have been integrated. Some GED researchers incorporate certain pollutants while addressing the cumulative properties of contamination in fish tissue; other researchers are examining ways to incorporate other contaminants.

Sources of Nitrogen and Nitrogen Pollution Control in an Urban Watershed
Richard Devereux, EPA ORD

Partners of this project included the Escambia County Water Quality and Land Management Division, the Florida Department of Environmental Protection, Cory Naval Air Station, and Florida State University. Richard Devereaux displayed a satellite image of the Bayou Chico area west of Pensacola and east of Perdido Bay. Escambia County has used funding received as a result of the Deepwater Horizon oil spill to restore Bayou Chico, including converting the waste systems of hundreds of homes from septic to sewer, closing or upgrading aging sewage treatment sites, and preserving and restoring several wetlands.

Key questions to consider while restoring the watershed include the following: How do nitrogen concentrations compare between Jackson and Jones Creeks? What is the source of the nitrogen? How is the nitrogen processed in the creeks? How do the creeks contribute to Bayou Chico water quality? What tools are available for water-quality management? To answer these questions, researchers used GIS, took wet and dry quarterly samples, analyzed water chemistry, and examined sucralose levels as an indicator for sewage presence. They concluded that nitrogen is higher in Jackson Creek than Jones Creek, most likely because of leaking septic systems. Nitrogen removal along Jackson Creek will provide the opportunity to enhance the processes. Sewer hookups should be prioritized, and expectations for water-quality improvement must be defined.

Karen H. asked whether the presence of clay in the area affects nutrient movement. Richard responded that the clay and sandy soil in the area affect nutrient movement, and levels of organic matter are low.

Training Workshop

Indigenous Research Frameworks
Neil Patterson, Jr. (Tuscarora Nation), SUNY College of Environmental Science and Forestry (SUNY-ESF) and Brian Ratcliffe, SUNY-ESF

Brian Ratcliffe and Neil introduced the session by reiterating that, as part of the TSC's process to identify national tribal science priorities, the TSC published a document in 2011 about the integration of tribal ecological knowledge (TEK) in environmental science policy and decision making. Neil described his experience in the establishment of the TSC by the National Tribal Operations Committee. He had asked at the time whether the TSC would focus on Western science in Indian country or EPA acceptance of TEK and indigenous science. The TSC has focused on both since its inception, and Neil has actively advocated for EPA acceptance of indigenous science. In its document about TEK, the TSC identified nine areas in which tribes and Alaska Native villages need assistance from EPA to help them to address their science issues. This presentation will address two of these needs: EPA staff should be appropriately trained on TEK policies prior to initiating activities and projects with affected American Indians and Alaska Native villages, and EPA should support opportunities for training collaboration between tribes and EPA. Neil is particularly proud that the following need was included in the document despite pushback from a TSC EPA Representative: EPA should recognize that land claims and rights within aboriginal territories are necessary to the protection of TEK.

Neil described the "dish with one spoon" metaphor—the first aboriginal environmental law established 2,000 years ago by the Haudenosaunee on Onondaga Lake—which captures the knowledge and concept that all resources are shared. He further expressed that the term "human well-being" is a foreign concept to his tribe because one cannot be human without having well-being; the two concepts are so integrated as to be redundant. The "Sowing Synergy" master's program established at SUNY-ESF integrates indigenous and scientific ecological knowledge (SEK) for sustainability and biocultural restoration, incorporating biocultural restoration and knowledge integration as required courses. Neil further explained that the original place names of the Haudenosaunee Confederacy describe the reference conditions of each location, which is why one requirement in one of the required courses is to learn the Mohawk language. For tribal members, to be human—and know the environment and have well-being—is directly related to the need to know and use their own aboriginal language.

Brian explained the tradition that every public meeting begins with an acknowledgment of "where we stand," which starts with knowing the history of the location. He displayed a 19th-century map of Pensacola, which was given its name by the aboriginal Pensacola people who lived in the area at the time of First Contact. He marveled at the history of Gulf Breeze, which was created from the negative act of ballast dumping and used as a quarantine center and, from this beginning, eventually rose to a place of prominence as an epicenter of important research.

Multiple ways of knowing exist, and each of the definitions for Western science and TEK could be imagined as applying to the other term; these definitions might fit the other better than expected. Additionally, the three words that make up the term "TEK" are problematic in themselves. The word "traditional" assumes that cultural practice is in the distant past and denies the adaptability and resilience of indigenous cultures. The word "ecological" implies that humans are separate from the rest of the world and limits indigenous knowledge to environmental topics. The word "knowledge" has a much broader meaning in the indigenous lexicon, in which it is used to connote a way of life.

Brian contrasted the Western ("*Gesellschaft*") and indigenous ("*Gemeinschaft*") worldviews, noting two important differences among many, including the differences in the stories that flow from each worldview. The first is that Western time is linear, whereas indigenous time is circular. The second is the difference in decision making. Western science revolves around term limits, fiscal years and an

individual's lifetime. Indigenous decision making focuses on seven generations, which does not necessarily refer to the following seven generations, but the three generations behind and following the current generation, which means that it is possible for one generation to know all of the seven generations. This is a powerful paradigm for decision making.

TEK and SEK are distinct and yet share common ground. As the TSC stated in 2011, the common ground is knowledge integration: TEK could and should be an important force in shaping scientific research. The combination of TEK with mainstream scientific research will enable a comprehensive response to environmental impacts on traditional lifeways. Furthermore, the *EPA Policy on Environmental Justice for Working With Federally Recognized Tribes and Indigenous Peoples* encourages the integration of TEK into the Agency's processes.

The question is how to integrate these related yet disparate worldviews, especially in the presence of power dynamics. To address this challenge, students in the graduate program were assigned to develop new metaphors to represent the integration of TEK and SEK. One potential metaphor is the Two-Row Wampum, the first treaty between a European country and a Native American tribe. This wampum was an agreement between the Haudenosaunee and the Dutch that the Haudenosaunee canoe would ride parallel with the Dutch ships, creating two never-ending, separate and equal parallel lines. Students thought that this could be a metaphor for TEK and SEK traveling along parallel paths. The next potential metaphor involves the powerful symbiosis of the traditional Haudenosaunee "three sisters" garden, in which beans, corn and squash provide one another with the requirements for each of them to grow. This symbiosis provides a blueprint for the world. Corn is TEK, emerging first and providing the scaffolding for the organisms that follow. Beans are the SEK, providing support and nutrients (Western-accepted evidence) for the TEK. Finally, squash are institutions, which can create and support the microclimate in which TEK and SEK can flourish together. The three sisters can teach many lessons. The third potential metaphor is "two-eyed seeing" (*etuaptmumk* from the Mi'kmaw language), which provides depth perception. In this metaphor, two-eyed seeing is learning to create balance and see from one eye with the strengths of indigenous knowledges and ways of knowing, from the other eye with the strengths of Western knowledges and ways of knowing, and learning to use both of these eyes together to benefit all.

Brian put these issues into context by showing an aerial image of Onondaga Lake, which is in the process of cleanup, and showing the past and potential future of the lake. The provisional landscape of Onondaga Lake is interesting because its stories simultaneously create a map and a calendar. The good health of North American lands at the time of First Contact is a direct result of Haudenosaunee management of the lands. Onondaga Lake also is a spiritual and political center; unfortunately, it now is seen as merely a recreational center and a site of waste disposal. Onondaga Lake is the location of nine Superfund sites. The Onondaga Nation shared its vision in 2005 for a clean lake and an offered a bicultural vision. In 2005, the Onondaga Nation filed a land rights action to regain the title for 2.5 million acres illegally seized by the state of New York. The vision for the lake cleanup, which emerged from this action, remains a living document. Worldviews are incorporated into restoration visions. For SEK, it is a biophysical worldview, whereas for TEK, the worldview is biocultural. Because of these conflicting notions of restoration (recreational versus subsistence/cultural), the determination of when a cleanup actually is complete often is contested. Industry considers Onondaga Lake clean because it can be used for recreation once again; however, the fish still are poisonous to eat. The Onondaga Nation will not consider the lake clean until the water and fish can be consumed safely.

Performing research in Indian country can be challenging because of distrust resulting from past research practices, historical trauma and lost cultural knowledge. Research can re-inscribe colonial dynamics in several ways, such as researchers asserting that TEK should be integrated into pre-existing scientific models and frameworks, plundering cultural intellectual property, causing damage to the community, collecting specimens, and breaking cultural protocols. The book *Decolonizing Methodologies* by a Maori

author provides one option for indigenous research frameworks based on a metaphor related to the tides, which includes the "processes that can be incorporated into practices and methodologies," as well as the "conditions and states of being through which indigenous communities are moving." Researchers can decolonize research by exercising the practice of "knowing where you stand," observing the protocols of respect, identifying themselves, identifying research priorities in partnership with indigenous leadership and communities, developing long-term relationships that allow knowledge-sharing processes to continue, providing research results that are immediately useful to the community, and ensuring that community members understand how their words are being represented before publishing them. Grantors should provide flexible funding to accommodate evolving research methods.

Brian concluded that the Center for Native Peoples and the Environment is a decolonizing force within SUNY-ESF and that TEK and SEK are powerful and distinct ways of knowing, embedded in particular worldviews. "Integration" requires decolonization, including a shift of power dynamics, acknowledgment of legacy trauma, and the centering of indigenous voices and knowledge. Research and other activities in Indian country should serve tribal self-determination. To advance tribal science, nonindigenous allies must engage with the entirety of Native life and culture.

Brian recommended the following sources for further illumination:

- *Decolonizing Methodologies,* by Linda Tuhiwai Smith
- *Indigenous Methodologies,* by Margaret Kovach
- *Braiding Sweetgrass,* by Robin Kimmerer
- *An Indigenous Peoples' History of the United States,* by Roxanne Dunbar-Ortiz
- *Wisdom Sits in Places,* by Keith H. Basso
- *A Sand County Almanac,* by Aldo Leopold

Eric Morrison explained that he has been advocating for the development of a TEK encyclopedia. He cited the need of Alaska Native villages to prove their land use to the federal government, and such an encyclopedia would help with this.

Elizabeth explained that the One Health Concept integrates environmental, animal and human health because information surrounding each type of health informs the others. Several federal agencies—such as the U.S. Department of State, Centers for Disease Control and Prevention, U.S. Geological Survey, and National Oceanic and Atmospheric Administration—have adopted the concept, but it has been a challenge for EPA's culture to adopt it. Bruce added that he recently attended a meeting about the One Health Concept and agreed that it is thriving at other agencies. Although many at EPA would like the Agency to adopt the concept, EPA must make the case for ecosystem services.

Lon commented that indigenous research frameworks must be incorporated into the "rubber meets the road" regulations, which is a challenge. Brian agreed and explained that the SUNY graduate program plans to explore this issue next. David Charters noted that it is necessary to determine the reasons EPA promulgated the existing laws. From his perspective, the Agency prioritizes human health and well-being over the environment. Lee Juan explained that his ancestors spoke about the two-way communication between all life forms, including plants, and he does not think that EPA is protective of the environment.

Karen H. asked whether it was possible to learn the Mohawk language online through a website. Neil was not aware of such a website but agreed to look through academic sources to find a language resource.

Tribally Focused Environmental Research Projects and Potential Partners

Wildlife Use of Seasonally Inundated Tree Islands in the Central Everglades
Craig van der Heiden and Daniel Hagood, Miccosukee Tribe of Indians of Florida (Miccosukee Tribe)

Craig van der Heiden displayed satellite images of the Miccosukee Tribe of Indians of Florida properties within the Everglades. Historically, the tribe resided throughout all of South Florida, but the conditions and land have changed drastically as a result of human action. The landscape in the Everglades consists primarily of sawgrass ridges and wet sloughs, with tear-shaped tree islands scattered throughout the landscape. Traditionally, the Miccosukee lived on these tree islands and also utilized them for farming, hunting and gathering. Tree islands within the Everglades also serve as biodiversity hot spots for plants and animals. Elevation is crucial in the Everglades, with even slightly different elevation gradients supporting completely different biological communities.

An early 20th-century decision to drain the Everglades and create farmland resulted in 1,750 miles of canals and levees. This has caused issues across the ecosystem, with areas that have too little or too much water and declining ecosystem health. Massive reductions in wading bird populations have occurred, as well as degradation of water quality. Native habitat has been lost to invasive vegetation, and 70 federally listed threatened and endangered native species reside in the area. The current water regulation schedule creates situations in which tree islands are flooded for extended periods of time. As a result, some areas have lost 98 percent of their tree islands.

Daniel Hagood showed a map of the historical natural flow of the Everglades compared to the current flow that has resulted from compartmentalization. Although some animals benefit from unnaturally increased hydroperiods within the Everglades (e.g., fish, some wading birds), many terrestrial animals struggle (e.g., deer, the federally endangered Florida panther). To address these issues, the tribe has examined the presence and movement patterns of fish, treefrogs and terrestrial animals on tree islands within Water Conservation Area 3A, which lies to the east of the Big Cypress National Reserve. The fyke nets and live traps resulted in the capture of 23 different species, including three exotic species and one rodent species. The treefrog survey found only native treefrogs. Camera trapping caught 20 species, including bears, which are more adapted to travel across the landscape to reach different tree islands. Because the tree islands are becoming rarer, the concentration of animals has increased. Bears benefit because food is more concentrated, whereas turtles do not benefit because their nests are more easily found and eaten by bears and other predators. Within the Miccosukee Federal Reservation, camera trapping and heat mapping are used to obtain population abundance estimates. Future projects will estimate animal density and collect animal movement data, resulting in more informed wildlife management.

Environmental Health Resources and Tools
Sandra Whitehead, National Environmental Health Association (NEHA)

NEHA has 6,000 environmental health professional members whose focus is on ensuring the safety of food, water and air and providing a healthful environment. NEHA supports capacity building by providing classes, resources and tools for environmental health professionals. Resources include the Tribal Drinking Water Course, an online course for tribal health departments on the public health aspects of safe drinking water; recreational water presentations from NEHA's virtual conference on recreational water (www.neha.org/eh-topics/water-quality-0/eh2o-recreational-waters-virtual-conference) that cover a broad array of topics; a private well course (nehacert.org/moodle/course/category.php?id=48) that provides basic understanding of wells and groundwater; and the Vector Control Tools and Resources Toolkit (www.neha.org/eh-topics/vectors-and-pest-control-0/essential-services), which includes a vector map. NEHA has expanded its offerings into the informatics space, with presentations designed to enhance knowledge regarding data use and provide information about the latest tools and resources to promote

data-driven decision making. A Tribal Water Program Improvement Resource Kit is available at www.neha.org/node/59282.

Overview of the National Tribal Water Council (NTWC)
Eric Morrison, NTWC

The NTWC has a diverse membership that serves as a technical and scientific body to assist EPA, federally recognized tribes and tribally authorized organizations in matters related to water. The NTWC advocates for the best interests of federally recognized tribes and Alaska Native villages and tribally authorized organizations in matters related to water, particularly the health and sustainability of clean and safe water and the productive use of water for the health and well-being of Indian country. The NTWC's priority issues include improving tribal access to clean drinking water, promoting education on mining impacts to water, working across all federal agencies on related water issues, addressing water quantity issues and impacts from climate change, enhancing coordination with tribal entities and tribal organizations, and developing relevant guidance and training for tribes. The NTWC submitted six comment letters to EPA in 2018 about various water-related issues, including the EPA General Assistance Program (GAP) guidance revision. The council currently is developing four additional comment letters. The NTWC briefed the National Congress of American Indians (NCAI) on water issues at the NCAI 75th Annual Convention and Marketplace that took place in Denver, Colorado, in October 2018 and is willing to brief tribes or other entities on water issues.

Alexa Olson asked whether the NTWC's concerns were related to environmental issues that fall outside of GAP parameters. Eric responded that the challenge is the information required for the new online application process.

Karen Gude encouraged interested TSC members to join the NTWC.

Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST) and EnviroAtlas: Mapping and Decision Making Using Traditional Knowledge
Steve Terry, United South and Eastern Tribes, Inc. (USET)

Steve Terry explained that USET was established in 1969 as a nonprofit, intertribal organization and represents the 27 tribal nations that are members of the organization. It is dedicated to promoting Indian leadership, improving the quality of life for American Indians, and protecting Indian rights and resources on tribal lands. USET is in the process of transferring the Tribal-FERST to the USET website so that tribal-based content can be added without having to undergo the federal government approval process. Tribal-FERST is intended to empower tribes by providing access to relevant science that can be used to develop sustainable, cost-effective solutions for reducing environmental exposures and health risks. Using this web-based, geospatial, decision-support tool, tribes can employ a holistic approach to address environmental concerns and plan for the future. USET created a Tribal-FERST roadmap that helps tribes to navigate the tribal assessment process after tribes supply their own TEK. The tool also generates environmental issue profiles about various topics (e.g., lead) and community data tables so that tribes can prioritize their environmental issues. Tribal-FERST allows tribes to determine the environmental health risks on their reservations using Western science and TEK and then assess the risks and develop solutions for a sustainable community. USET also will host the EnviroAtlas interactive map, a web-based, tablet- and smartphone-compatible geospatial tool that allows tribes to search data layers, create a subset of layers, filter data, and utilize analytical tools. Participants watched a tutorial video demonstrating how to use Tribal-FERST.

Brian asked how often the data are updated. Steve replied that 2016 data currently are being input. National-level ambient air data comprise most of the air data.

Beth Jackson asked whether the tribal boundary information was being updated in EnviroAtlas. Steve responded the information is being input, and tribes can add their own data.

Bruce encouraged the participants to let EPA know when they find tools useful so that the Agency will continue to support them.

Tour of the GED Facility

The TSC members were given tours of the wet, coral, ecotoxicity, proteomics and genomics laboratories, as well as a tour of the field-sampling workspace.

"Speed-Learning" Session (Ecotools Café, Posters and Demonstrations)

TSC members, GED scientists and guest presenters interacted with one another, learning about different tools, topics and tribal science needs. The goal of the session was to facilitate interactions between tribal members and EPA scientists that can lead to longer term information sharing and collaborations.

Participants learned about the "Human Well-Being Index" from Linda Harwell, "Restoration Prioritization Using Benefit Indicators" from Justin Bousquin, the CyAN (Cyanobacteria Assessment Network) App from Yongshan Wan, or WebICE (Web-Based Interspecies Correlation Estimation) from Sandy Raimondo.

The following posters were presented during the poster session:

- "Biological Condition Gradient: Applying a Framework for Determining the Biological Integrity of Coral Reefs," by Debbie Santavy.
- "Characterizing Natural Hazards Resilience in Coastal Shoreline Counties," by Lisa Smith.
- "Comparative Transcriptomic Response of a Model Fish and Amphibian to Trifloxystrobin Early Life Stage Exposures," by Candice Lavelle.
- "Cyanobacterial Community Structure Changes With Seasonal Mixing and Dissolved Oxygen Dynamics in Three Urban Eutrophic Lakes," by John E. Rogers.
- "Save Two Birds With One Stone: Protect Listed Species and Ecosystem Services in Geographically Isolated Wetlands Using Community-Level Protection Goals," by Leah Oliver.

ORD StRAPs Updates

Tribal Engagement Update
Dave Kryak, Lead Coordinator on Tribal Engagement, EPA ORD

Dave Kryak provided a follow-up to the StRAPs discussion that was held during the TSC's Summer 2018 Face-to-Face Meeting in Cincinnati, Ohio. He summarized that ORD is in the process of developing its research portfolio for the next 4 years and identifying the research needs for priority problems identified by its partners. ORD has received input from tribes, states and other partners and drafted a StRAP for each of the office's six research programs. These documents are being reviewed by EPA's Board of Scientific Counselors.

The next step is formal consultation with tribes, which is expected to occur from February 5 to May 6, 2019. The consultation for the Chemical Safety for Sustainability Research Program and Human Health Risk Assessment Research Program StRAPs will be combined. The primary purpose of these

consultations is to obtain tribal input about the outputs included in the StRAPs. ORD will engage tribal environmental managers informally and then conduct formal consultation with tribal leaders of all federally recognized tribes. The outputs as written are flexible enough to be adjusted to more specific problems. ORD will continue to engage with the TSC and other EPA-Tribal Partnership Groups to develop products that lead to the desired outputs. These partnerships will continue throughout the 4 years of the research cycle as ORD conducts the research and moves toward the outputs.

Summary of Safe and Sustainable Water Resources (SSWR) Research and Its Relationship to Tribal Science Research Needs
Rick Greene, Associate National Program Director (NPD) of the SSWR Research Program, EPA ORD

The draft SSWR StRAP for fiscal years 2019–2022 includes three overarching topics, 10 research areas and 30 draft strategic outputs. Cross-NPD coordination has occurred regarding the topics of biosolids (e.g., PFAS), wildfire, coastal resiliency, toxicity testing, technical support and risk assessments. Using the input from the TSC and other EPA-Tribal Partnership Groups, the SSWR Research Program began to link the identified tribal science research needs to the SSWR research areas. The three research areas within the overarching topic of watersheds are: (1) assessment, monitoring and management of aquatic resources; (2) human health and aquatic life criteria; and (3) the Animas-San Juan Watershed Water Quality Monitoring and Modeling Program. The three research areas within the overarching topic of nutrients and HABs are: (1) assessment and management of HABs, (2) science to support nutrient-related water quality goals, and (3) assessment and management of nutrients. The four research areas within the overarching topic of water treatment and infrastructure are: (1) drinking water and distribution systems, (2) wastewater and water reuse, (3) integrated stormwater management, and (4) technical support. Each of the seven identified water-related tribal science research needs has been linked to one of the 10 SSWR research areas listed above.

Rick Greene provided a list of recent water-related national priorities and Science To Achieve Results (commonly known as STAR) grants areas and explained that SSWR has an active webinar series, with 40,426 attendees participating since its inception in January 2015.

Neil asked whether the StRAPs provide an opportunity to address water policy issues that affect tribes. Tribal water rights and primacy issues are important, and tribes need to see EPA following through with its trust responsibility regarding promulgating water rights and policies that ensure that tribes have the rights to their aboriginal waters. Karen G. explained that this issue is outside the purview of the StRAPs, but the NTWC is active in this area.

José noted that the StRAPs provide a forum to establish collaborative research, and ORD will find collaborators and partners to move the projects forward. The TSC needs to consider what collaborations it can help to foster within the six ORD research programs.

Closing and Adjournment

Rick D. and José thanked the participants for their patience and adaptiveness and adjourned the meeting at 5:25 p.m.

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