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Incorporating Ecological and Social Benefits into Land Planning and Development through Integration of Engineering With Nature® (EWN®) and Landscape Architectural Practices

Paper:

The U.S. Army Corps of Engineers (USACE) is responsible for maintaining coastal navigation assets in the United States that include: 1,067 navigation projects, 19 lock chambers, 13,000 miles of channels, 929 navigation structures, and 844 bridges. USACE inland navigation assets include: 27 inland river systems, 207 lock chambers (at 171 lock sites), and 12,000 miles of inland river channels. In many instances, USACE-maintained assets and/or future-anticipated, water-dependent projects offer opportunities to incorporate ecological and social benefits while still accomplishing the desired engineering outcomes. Recently, the USACE's Engineering With Nature® (EWN®) Initiative (www.engineeringwithnature.org) commenced a research and development project that is investigating ways to facilitate the aforementioned, "value-added" approach to infrastructure through more deliberative collaborations with a team of landscape architects. By way of background, the EWN Initiative enables more sustainable delivery of economic, social, and environmental benefits associated with water resources infrastructure through a program of activities that sustainably deliver economic, environmental, and social benefits through collaborative processes.

As disciplines, the EWN Initiative and landscape architecture (LA) consider many of the same opportunities related to infrastructure design and performance, such as the re-imagining of existing infrastructure to meet more diverse and functional engineering criteria, providing greater ecological value, and delivering recreational opportunities as well as aesthetic benefits. While EWN engineers and scientists are knowledgeable about natural and engineering processes and appreciate the "value added" when integrating the two to support a water-based, infrastructure project, landscape architects (LAs) are formally trained to think about how people interact with a design. LAs translate the conceptual stage of a project directly into a specific drawing, using a visual vocabulary for communicating how natural processes can be integrated into traditional engineering projects. Given the complimentary nature of these two disciplines and mutual interest in infrastructure enhancement, a collaborative effort was pursued to further promote those shared design principles and precedent knowledge, which can be integrated into EWN approaches that are collaboratively pursued among engineers, hydrologists, biologists, ecologists, and landscape architects.

In 2018, USACE's EWN Initiative funded an R&D work unit that explored opportunities to integrate EWN techniques/practices into conceptual designs for USACE Districts' infrastructure. Scientists and engineers with the US Army's Engineer Research and Development Center's (ERDC), working collaboratively with landscape architects affiliated with the Dredge Research Collaborative (DRC), identified several projects to evaluate. Those projects included, but are not limited to: Comite River Diversion Canal (Louisiana, US), Moses Lake Tide Gate (Texas, US), Port Arthur Levee System, (Texas, US), W.P. Franklin South Recreation Area, (Florida, US), and the Moore Haven Lock & Dam, (Florida, US).

Initially, the Project Delivery Team (PDT) received preliminary data and information about the proposed projects from USACE Districts' Project Managers. This was followed by onsite meetings at the respective project sites that included visual inspections of the existing infrastructure and surroundings. In many instances, several stakeholders and/or local sponsors for the projects also participated in the site visits. This additional dialogue and insight proved helpful with initial exploration of EWN techniques/practices that should be considered. Upon conclusion of the site visits, the PDT began the process of integrating innovative, EWN and LA design strategies into updated project drawings.

The previously referenced projects were extremely diverse and offered very different opportunities to incorporate EWN strategies into the updated designs. For example, the PDT proposed several alternatives for the Comite Canal Project that included a horizontal levee system; "floodrooms" and side-cast hills, and a bayou passage for fish. Similarly, the Moses Lake Tide Gate Project offered unique opportunities to propose terraces and eco-friendly armoring along the gate zone. Enhancing human use benefits, which could be derived from the USACE projects, was also of primary interest to the PDT. For most projects, it was readily apparent to the PDT how community/social benefits could be incorporated. The Comite Canal Project offered opportunities to incorporate a community park, walking trails, and kayaking opportunities. Similarly, the Moore Haven Lock and Dam Project offered opportunities to restore the project area by excavating sediment to create wetland pockets for kayakers. In turn, the excavated material would be moved to upland sites for the purpose of creating pollinator habitats, native ecosystems, and associated walking trails.

In support of each project, the PDT prepared numerous drawings that depicted a variety of methods for incorporating EWN/LA strategies. In turn, these "strategy diagrams" were presented to the applicable USACE District Project Managers for their review and feedback. This step constitutes a hallmark attribute of the EWN Initiative, which is the desire to collaboratively develop projects that result in environmental, social and economic benefits (i.e., triple win outcomes). The project managers were provided a presentation that highlighted the various design options being recommended. Following a question and answer session, the district representatives offered the PDT comments and recommendations to further enhance the project ideas relative to the overall project construction, budget, localized environmental conditions, regulatory constraints, and community interest in the project. Information and feedback from the USACE District staff were recorded and subsequently synthesized into a preferred design concept for each project.

Each preferred design concept combined the design strategies, which the district representatives and the PDT found most desirable, into a single integrated proposal. For example, the Comite Canal proposal combined several design strategies. One leveraged the material excavated during the construction of the canal to build mounded hills, providing both habitat diversity and recreational trails for walkers, runners, and bicyclists. Another design concentrated a large volume of that material at one end of the canal to construct a large hill, which in the flat terrain of south Louisiana, would become a unique overlook and major recreational feature. A third design proposed 'aeration cascades' along existing bayous that intersect with the canal, enhancing in-canal water quality. Ultimately, the preferred design concept for each site became the basis for the production of LA renderings.

Producing LA renderings is a valuable technique that can be leveraged to convey information about a project and its integration with the surrounding environment. Using standard orthographic and perspectival representation techniques including plan, section-elevation, section-perspective, and aerial perspective, LA renderings can depict the intended conditions of a completed project. Various dimensions of a proposed project, such as how it would be experienced by recreational users, how it would provide engineering benefit, and how it might develop as habitat for plant and animal species, can be both illustrated within renderings and described by annotations layered on top of renderings. LA renderings can also be used to make before-and-after comparisons between existing conditions- captured in photographs, and proposed conditions- shown in the renderings. Such drawings can offer various audiences, including decision-makers, project planners, and the public, greater insight into future-anticipated changes to environmental conditions and/or the addition of human-use benefits. For the projects evaluated as part of this R&D work unit, the PDT leveraged the initial drawings and input from the USACE District representatives to produce a series of renderings for each project. Renderings were developed through an iterative process that included hand-

sketched drafts to establish the intentions for and character of each set of renderings, the construction of 3D sketch models in Rhinoceros 3D (a modeling program), photo-collage techniques in Adobe Photoshop, and finishing in Adobe Illustrator.

Following the production of renderings, the PDT developed reports for each of the districts that described methods for integrating EWN/LA practices and/or designs into the respective projects. In general, the reports consisted primarily of a description of EWN/LA methods, project evaluation/analysis, supporting drawings and renderings, and recommended next steps. The reports also chronicled the PDTs efforts to engage the USACE District's project managers and the associated discussions pertaining to review of the initial drawings, which ultimately evolved into completed LA renderings. For each of the projects evaluated as part of this R&D effort, enhancement of environmental and human-use benefits was identified as an important consideration that would create added value for the overall project. For example, the Comite Canal Project (Louisiana, US) was designed for the purpose of conveying storm water during 100-yr storm events. Using an EWN/LA approach, the PDT offered additional insight with respect to the addition of fish passages, riffle-pool sequences, recreational trails, and a park with interpretive signage. EWN analysis of the proposed Moore Haven Lock and Dam Project (Florida, US) also resulted in innovative strategies for establishing native vegetation at locations within the project boundary that have been historically degraded. Moreover, the PDT successfully integrated additional recreational features such as walking trails, inundated/digressional bays and inlets for kayak access.

In every circumstance, the PDT found ways to incorporate EWN/LA practices to achieve additional environmental and social benefits while not interfering with the originally-intended, engineering and/or basic project purpose and need.

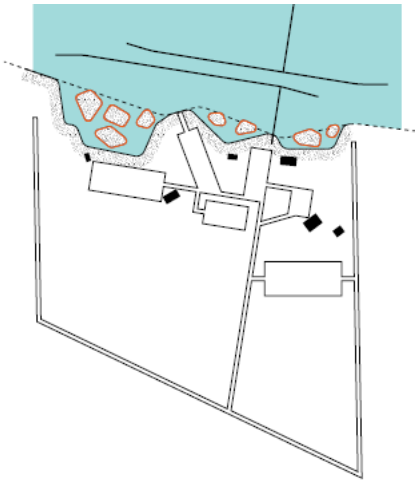

Figure 1 (Left): Picture of beach located at W.P. Franklin South Recreational Area. This beach and the adjacent upland area are being considered for restoration.

Figure 2 (Right): An initial "strategy diagram" that was developed to highlight one restoration option for the beach. This design supports the creation of islands that are conducive to the growth and viability of mangrove trees. Such "strategy diagrams" and subsequent renderings help stakeholders, resource managers, and project sponsors better understand how the resulting project will integrate with the existing landscape.