7.0 SUMMARY

The Habitat Characterization Study was commissioned to document the physical, chemical, and biological characteristics of selected effluent-dependent waters in the arid West. The study was not conducted to scientifically verify any particular hypothesis, but to collect data to objectively characterize effluent-dependent ecosystems. The need for this activity was generated by the frequently asked and fundamental question: *When we implement water quality programs in effluent-dependent waters, what are we trying to protect?*

To answer this question, the project purposefully selected 10 effluent-dependent waters to be study areas that represent a wide variety of ecoregions, watershed sizes, effluent treatment capabilities, and effluent discharge volumes. The benefit of this approach was twofold. First, it provided considerable insight into the range of physical, chemical, and biological attributes present in effluent-dependent waters, and second, this approach provided an opportunity to identify commonalities and differences among areas that could form the basis for focused research on specific elements of these ecosystems.

One of the key outcomes of the characterization of effluent-dependent waters was the development of an effluent-dependent stream ecosystem model. This model, based on accepted stream ecosystem concepts, encapsulates observations from the 10 study areas. Most importantly, the stream ecosystem model illustrates how the discharge of effluent to an ephemeral or intermittent river represents a discontinuity in the existing natural stream ecosystem. Associated with this discontinuity is (1) a physical habitat that may be out of equilibrium with the discharge volume; (2) water quality that is defined by the effluent quality; (3) an aquatic community that responds to the physical and chemical template created by the discharge; and (4) a riparian community that typically develops in quality and extent with increased distance downstream of the discharge.

Because effluent quality typically defines the water chemistry of the effluent-dependent water, especially nearer to the point of discharge, implementation of regulatory requirements for the permitting of WWTPs creating the effluent-dependent water has been focused on producing as "clean" an effluent as possible. This effort has been guided by the belief that "cleaner" effluent will result in "better" aquatic communities. *However, the review of both historical and site reconnaissance data suggests that there are limits to expectations for the aquatic communities of effluent-dependent waters.* For example, at high levels of treatment (e.g., nitrification and denitrification), improvements to the aquatic community are limited. Only at the highest levels of treatment, where filtration is added to the treatment process following nitrification and denitrification, does the aquatic community (macroinvertebrates) shift in composition such that there is an increase in the abundance of "cleanwater" taxa. However, even at the highest level of treatment, the richness of "cleanwater" species remains low.

These results from the study areas suggest that regardless of efforts to create a "clean" effluent, there are limitations to what can be expected as a response in the aquatic community. There are certainly other benefits to implementing high treatment levels (e.g., removal of persistent chemicals in the environment); however, implementation of this high level of treatment typically will not be manifested in typical measures associated with the aquatic community (e.g., in abundance and diversity). Consequently, *if the aquatic community is used as the basis for evaluating success of the implementation of point source controls, then because of apparent limitations in potential community response, the addition of increased treatment may not result in any observed benefit.*

Reasons for the lack of any observed benefit in the aquatic community, even with increased treatment, likely stem from the obvious physical impacts on the effluent-dependent waters characterized for this study. Effluent, by its very nature, is produced in greater quantities with increased population. Thus, *effluent-dependent waters tend to be associated with urban environments, where the impacts on stream ecosystems can come from many sources independent of WWTP operations, administration or regulation* . For example, the majority of the river channels at the 10 study areas had been channelized for the purposes of flood control. At other sites, grade control structures had been installed to manage channel structure.

The effect on aquatic communities of anthropogenic attempts to control the physical dynamics of these streams cannot be overstated. NPDES permit effluent limitations, based on water quality standards, traditionally form the basis for protection of aquatic life in all waters, regardless of the waterbody type (e.g., coldwater or effluent-dependent). It is assumed that meeting water quality standards should result in increased numbers and kinds of aquatic species, even in created habitats. Yet if the implementation of wastewater treatment improvements yields little to no enhancement in the aquatic community, we must assume that other limitations, likely habitat-related, exist. Moreover, *continued emphasis on improving treatment without addressing the limiting factor may lead to the likelihood of effluent being diverted for water reclamation activities to recoup costs.* The net result of this unintended consequence can be the loss of effluent-supported riparian habitat.

The Clean Water Act explicitly provides for the protection of aquatic life and wildlife, but the emphasis in permitting has been almost solely on the protection of in-stream conditions. Little to no consideration is placed on riparian ecosystem protection, especially from the perspective of supporting and potentially enhancing riparian habitat and associated wildlife species. This may be shortsighted, especially in arid environments where there are significant but unrecognized environmental benefits achieved from effluent-supported terrestrial habitats.

We believe that the traditional approach of establishing effluent limits in effluent-dependent waters, solely for the purpose of protecting an aquatic community that may not be attainable, needs reconsideration, especially in regions where water resources are limited. Instead, using an approach that recognizes ecological benefits gained in effluent-dependent ecosystems, even if outside of the water column, would be a step forward. Under this approach, *alternative biological performance measures that use "success criteria" mitigation could be considered as a means of measuring compliance with the goals of the Clean Water Act.* This direction has been pointed out by the USACE, which developed performance standards for wetlands. Moreover, decisions regarding where resources should be expended could be based on a decision-making approach that uses concepts associated with ecological restoration or rehabilitation.

Establishing non-traditional alternatives for measuring permit compliance may be a cost-effective and ecologically sound approach that recognizes the environmental benefits of having water flowing in an otherwise dry channel. Moreover, *alternative outcomes that optimize the terrestrial habitat would support watershed-level permitting, ecological restoration, reduce the loss of riparian habitat in the arid West, support restoration of urban rivers, and benefit threatened and endangered species.*

Some of the discussion and ideas presented in **Chapters 5 and 6** of this report may seem to be "outside of the box" with regards to implementation of the Clean Water Act. However, as noted in **Chapter 6**, other organizations have reached a similar conclusion – addressing unique environmental management issues requires innovation. We believe that *many of the tools needed to implement innovative approaches to environmental management already exist*, and interestingly, many of these tools were established to address unique environmental issues. We believe that is time to consider applying these same types of tools to address another unique environmental issue – effluent-dependent waters.