5.0 Overview of History and Evaluation of Regulatory Effectiveness

5.1 The Approach to Evaluating Regulatory Effectiveness

Cumulative impacts have occurred in the Peace River watershed since the 1940s with the greatest impacts having occurred in the years prior to regulation. Earlier decades were characterized by relatively limited regulation, corresponding to lower population pressures and less intensive land and water uses. Regulatory initiatives became dominant in the 1970s and 1980s, and continue to grow in response to population pressures and the changing political climate.

The challenge in evaluating regulatory effectiveness over the course of 60 years of change is to separate the effect of regulation from everything else that has happened. The use of ground water, by example, has been affected by the progressive enactment of legislative acts and implementing rules. The fact remains that ground water use predated the adoption of any regulations and was already having an impact at the time regulations were enacted. In addition, the effect of any single regulation is inserted into the continuum of ground water use over time, such that existing ground water wells probably remain unaffected for various periods following implementation, depending on a host of special circumstances.

As is evident from the history of regulations, there is a pattern of regulatory activity treading rather lightly at first and progressively becoming more prescriptive with time. Thus, again with the use of ground water by example, there have been a series of enactments, rule adoptions, and interpretations of laws and rules coming into effect through the course of time. Typically, these regulations are responses to the perception of impacts, moderated by the economic dependencies that have developed around the regulated activity, and they are not, therefore, entirely science-based measures subject to rigorous cause-effect analysis.

Regulation has not, however, been the only reaction to resource management issues. Mainly because of the ambiguity of causal relationships and the inherent complexity of managing resources on a watershed scale – both above and below ground – regulation is more and more often supplemented by resource management programs with the flexibility to collect scientific data and address issues that may be outside regulatory purview. Regulations and programs have developed side-by-side and represent a continuum of governmental response. For that reason and because the resource management plan to be adopted for the Peace River watershed is required to identify regulatory and non-regulatory actions, this report addresses these programmatic responses as part of regulatory effectiveness.

Even with the combined effect of past and continued regulation and resource management programs, cumulative degradation of natural resources in the Peace River watershed has persisted. While there may be a temptation to scapegoat programs, agencies, or branches of government, over the course of six decades, there has been a heightening of legislative interest and action, a tightening of regulatory control, a flood of programmatic funding, and increased litigation over the application of regulation. One could argue that the sum of these activities constitutes a broad public response to some of the cumulative impacts documented in this study. The questions that remain are those related to whether the response is strong enough and effectively targeted to arrest the documented decline in the watershed, and whether some types of cumulative impacts are only now being recognized and require action?

The efficacy of existing regulations has already been tested by legal challenges. Just within the past decade, for instance, there has been significant litigation over proposed rules and activities within the Peace River watershed (e.g. challenges to the Southern Water Use Caution Area (SWUCA) 1992 rule, the Peace River/Manasota Regional Water Supply Authority's water use permit, and phosphate mining permits). These have not been one-sided affairs with regulated interests merely litigating for relief. Neither have they been about activities and rules with narrow applications. The SWUCA rule challenges from both private interests and local governments dealt with the fundamental efficacy of the science underlying the proposed rule, as well as the prescriptions for remedy. This rule, which was adopted after hundreds of hours of broad public and elected official participation, was not hastily conceived or ineptly drawn. The administrative law judge required 16 months to review the evidence and law, and the final order was mostly affirmed by the courts. The lesson from SWUCA is simply that as regulatory programs have become more complicated in response to continued pressure on the resources, they have become more difficult to enact, even within the broad statutory frameworks enjoyed in Florida.

Once regulatory programs are in place, their implementation may be challenged whenever an agency takes a final agency action. This framework, provided under Chapter 120, Florida Statutes (FS), provides a continuum of opportunities to review and interpret statutory and rule language as it applies to specific permits. In the case of phosphate mining permits in the Peace River watershed, two public agencies initiated challenges to proposed permits, arguing in essence that the issuance of the permit would result in cumulative adverse impacts. The outcomes of these challenges have varied with the specifics of each case, but more than $12 million public dollars have been spent on these challenges. Under this kind of repetitive review then, it is hard to imagine that either the regulatory agency or the permit applicant will stray from the boundaries prescribed in law.

So, in two cases, one where the regulatory agency explored the limits of its authority and another where public agencies challenged the interpretation of regulatory authority exercised by an executive agency, the outcomes have hinged on the legislative grant of regulatory authority.

There are many regulations affecting the state and nation other than those cited above, which almost uniquely impact the Peace River watershed. As with the SWUCA rules, interested parties from all sides have challenged rules at both federal and state levels. For example, the current implementation of Total Maximum Daily Loads (TMDLs) for impaired waters is the result of federal lawsuits initiated by environmental groups against various states and the U.S. Environmental Protection Agency (USEPA). Florida's Impaired Water Rule has been reviewed under challenge, as has its Environmental Resources Permit Rule. Both regulated interests and environmental advocacy groups usually participate in rule development and challenges, making it not unreasonable to assume that, over the long run, the full measure of granted regulatory authority (as determined by courts) is exercised. In the face of cumulative impacts documented in this report, there may be gaps in regulatory authority that need to be plugged, and there may be a need to look for other tools to address the on-going cumulative impacts.

This section of the CIS document sketches the development of state regulations affecting the Peace River over the past four decades. The goal is to summarize and build an understanding of the essential character of the existing body of regulation as it has evolved over time.

5.2 The History of Regulation Affecting the Peace River Watershed

This section of the report attempts to summarize and provide an understanding the effectiveness of regulations that were in place during the period that cumulative impacts occurred, how the body of regulations grew, what problems were addressed, what limits were set, how well they were implemented, and how this implementation may have changed over time with changing public perceptions and adaptation by those who were regulated. The following sections of the report address and summarize specific topics.

5.2.1 Early Regulation

Commencing in 1953 with artesian well legislation, the State progressed through a series of study commission reports, regulatory legislation, creation of flood control districts, reorganization of the executive agencies, and a constitutional amendment in response to increasing concerns about environmental degradation and potential limitations on water supply through the 1960s. At first tentative and cautious, these efforts became more forceful with time, culminating in 1968 with adoption of the public trust doctrine in the Florida Constitution.

5.2.2 The 1970s – Watershed Years for Water Regulation

Federal and State regulation emerged in full force in the 1970s. The keystone Florida water legislation was the Water Resources Act of 1972, which has provided the framework for water resource regulation through the present. SWFWMD adopted rules in 1974 for planning, constructing, and operating necessary water management works in the Peace River watershed, rules to regulate water well construction and water use, and rules to regulate the management and storage of surface waters. The Environmental Reorganization Act of 1975 created the state agency regulatory structure that would persist until the mid-1990s. In 1978, SWFWMD established minimum flows and levels at specific locations throughout the district, including lakes within the Peace River watershed.

5.2.3 Land Use Regulation

The Florida Land and Water Management Act of 1972 established a process of regulating Developments of Regional Impact (DRI), identifying 11 types of development that would trigger additional review. Later, the Administration Commission adopted additional types of development, which have the potential for DRI review. The DRI review results in a development order issued by a local government, approving with or without conditions or denying the proposed project. These development orders are reviewed by the regional planning councils and can be appealed by the Department of Community Affairs.

5.2.4 Ground Water, Storm Water, and Wetland Regulations

In the early 1980s, storm water treatment regulations were adopted by the State and implementation in the Peace River watershed was delegated to the SWFWMD. Wetlands protection legislation in 1984 added criteria for permitting, and SWFWMD followed with revised rules for the management and storage of surface waters the same year. Following a legislative directive to regulate isolated wetlands by 1987, SWFWMD again revised permitting rules, but exempted phosphate mining from its permitting. Future ground water availability concerns led the Florida Legislature to mandate ground water basin resource availability inventories, which eventually led to the adoption of the Southern Water Use Caution Area over the Peace River watershed.

5.2.5 Consolidation and Streamlining

The Florida Environmental Reorganization Act of 1993 provided for the assumption of delegation of the federal National Pollution Discharge Elimination System program and the consolidation of wetland resource, mangrove alteration, and surface water management permits into a single state regulatory approval: the Environmental Resource Permit. The Department of Natural Resources and Department of Environmental Regulation were combined to form the Department of Environmental Protection. These changes eventually brought phosphate mining under the same permit review as other forms of development. Mitigation areas and mitigation banking were authorized, which resulted in the formation of two mitigation banks in the Peace River Watershed.

5.3 Programmatic Responses

A number of regulatory activities can be viewed as programmatic responses to specific impacts resulting from specific or groups of activities. The following topics are addressed.

5.3.1 Southern Water Use Caution Area (SWUCA)

- 5.3.1.1 History Leading to SWUCA
- 5.3.1.2 SWUCA Management Plan
- 5.3.1.3 Administrative Law Judge Ruling
- 5.3.1.4 SWUCA II – The Southern Water Use Caution Area Recovery Strategy
- 5.3.1.5 Regulatory Component

5.3.2 Nonmandatory Phosphate Reclamation

- 5.3.2.1 Nonmandatory Land Reclamation Program (NMLRP) 1980 through 2005
- 5.3.2.2 NMLRTF and the Severance Tax

5.3.3 Minimum Flows and Levels (MFLs)

5.3.4 Agricultural Ground and Surface Water Management Program (AGSWM)

5.3.5 Integrated Habitat Network/Coordinated Development Area: Lease Nos. 3963, 3995, and 4236

5.4 Regulated Activities

There are many ways to categorize regulated activities, but for the purposes of this study and its specific mandate, we believe four categories best portray the insights we have developed into the effectiveness of regulation to address cumulative impacts. These categories are addressed as part of this study.

5.4.1 Agricultural Drainage and Water Use

5.4.2 Phosphate Mining and Mandatory Reclamation

5.4.3 Urbanization and Industrialization

5.4.4 Public Water Supply

5.5 Gaps in Regulatory Effectiveness

The CIS identifies that there has been a number of cumulative adverse impacts to the hydrology, water quality, and native land covers within the Peace River watershed. Many of these cumulative impacts began long before the baseline period for the study (1940s), but most seem to have accelerated within the study period. The loss of spring flows, the conversion of over 136,000 acres of wetlands to other uses, the loss of 343 miles of streams, and the mineralization of streams are prime examples of these trends.

One of the challenges of the study is to determine the adverse effects that occurred before regulations were enacted versus those that have occurred after regulation as a result of an exemption, permit, or reclamation plan. This challenge to compare before and after the start of regulatory controls would be easier had regulations been enacted and implemented within a relatively short time. In reality, regulations have accumulated over the study period. Over the course of five decades, agencies worked legislative enactments into rules, rules into policies, and policies into programs. Throughout this period, the Legislature enacted new regulations as new concerns arose. This dynamic of an active governmental process responding to environmental concerns during a period of population growth and land use change within the Peace River watershed is integral to our society, but it makes our comparison less concise because of the frequent revisions. This study, therefore, presents the cumulative impacts and the way they are currently addressed. Constructive evaluation of current regulations and non-regulatory programs in light of their history and the causes of cumulative impacts documented in this study are also reviewed. The following topics are addressed in the Cumulative Impact Study report.

5.5.1 Reductions in Base Flow

5.5.2 Water Quality Degradation

5.5.3 Native Habitat Losses

5.5.3.1 Native Upland Habitat
5.5.3.2 Wetlands
5.5.3.3 Streams

5.5.4 Threats to Public Water Supply

5.6 Use of Buffers within the 100-Year Floodplain

The enabling legislation specificially required that the CIS address the environmental benefits and economic costs associated with enhanced protection of the 100-year floodplain in the Peace River watershed. The two most effective approaches to flood protection are to avoid siting incompatible land uses within flood-prone areas and to ensure that land development does not alter natural patterns of water movement and storage. This preventive strategy is commonly referred to as the “non-structural” approach, because the emphasis is placed on harmonizing growth and development with the natural environment. Conversely, a “structural” approach involves the intentional alteration of natural surface water systems though construction of facilities, such as ditches, canals, dams, and control structures, to ensure that formerly flood-prone areas are less prone to inundation. This can be a long, costly process with significant environmental impacts, including the alteration of natural aquatic and terrestrial habitats and the acceleration of storm water pollution of water bodies. The following topics are included in this portion of the document.

5.6.1 Floodplain Restrictions

5.6.1.1 Flood Protection
5.6.1.2 Floodplain Permitting
5.6.1.3 Restrictions on Floodplain Development
5.6.1.4 Floodplain Compensation
5.6.1.5 Floodplain Compensation in Detention Ponds
5.6.1.6 Minimal Impacts by Single Projects vs. Cumulative Impacts

5.6.2 Ecological Value of Buffers

5.6.2.1 Water Quality
5.6.2.2 Stream Flow Moderation
5.6.2.3 Wildlife Function
5.6.2.4 Buffer Width
5.6.2.5 Buffer Width Determination

5.7 Recommendations for the Peace River Watershed Management Plan and Future Actions

The final portion of this section of the CIS proposes a number of actions for consideration in conjunction with the upcoming Peace River Watershed Management Plan or future FDEP/SWFWMD programs and actions.

General

- Update the land use change analysis with 2005 aerial photography to measure the rate of change since 1999 under current regulations.

  Environmental regulations were being developed and implemented between 1979 and 1999, the dates of the two sets of aerial photographs from which we made comparisons of land cover. Losses of wetlands were unexpectedly large and raise a question about regulatory effectiveness because we cannot definitively determine whether those losses occurred after protective isolated wetlands protection was phased in. By comparing 1999 land covers to 2005 land covers, however, we will be able to assess definitively the effectiveness of wetlands protection regulation.

- Monitor cumulative impacts at the watershed level, not at the individual permit level, and adjust existing or develop new regulatory and non-regulatory programs to minimize or eliminate cumulative impacts of continued development.

  The current regulatory framework has failed to minimize cumulative impacts. One reason for this is undoubtedly the current practice of addressing cumulative impacts for each permit action. This straw-that-breaks-the-camel's-back approach is a mismatch of scales and begs issues of fairness to applicants. The mismatch of scales means it is harder to attribute a cumulative effect to many small users than to find that a single large user may have a cumulative effect. The fairness and efficacy of permitting decisions is questioned, of course, when one user is denied after many have been issued permits. A better approach is the one used by SWFWMD in its SWUCA Recovery Plan. The agency will evaluate permits against rule criteria, while continuously reviewing the resource impacts as a guide for changing the criteria. Should the resource continue to decline, the agency will adjust permitting criteria for all applicants – not simply deny the permit that "breaks the camel's back." This approach relies, of course, on a completely objective analysis of cumulative trends and the periodic adjustment of rule criteria in response to these trends.

- Continue to use voluntary, incentive-based programs, such as Quality of Water Improvement Program (QWIP), Back-Plugging Funding Assistance initiative and Facilitating Agricultural Resource Management Systems (FARMS), to augment regulation, but strengthen the regulatory "backstop" to ensure compliance and equitable distribution of burdens.

  Participation in remedial programs offered by SWFWMD for the Shell Creek, Prairie Creek and Joshua Creek Watershed Management Plan has been far from universal (about 30% of landholdings) and the burden of meeting water quality goals may not, therefore, be equitably distributed. Without a more clearly discernable regulatory alternative for non-participation, many operators are apparently taking a wait-and-see approach. In the event that water quality goals are not met within the management plan timeframe, the regulatory controls implemented as a result will seem severe. This recommendation is to gradually increase the regulatory pressure for participation in an effort to avoid a more severe regulatory outcome that is already authorized under state law in the event that voluntary participation is insufficient to meet water quality goals.

Stopping Wetland and Stream Losses

- FDEP, in coordination with SWFWMD, should audit wetland losses since 1979 to understand how more than 4,000 acres of wetlands were lost to urban development, and over 13,000 acres were lost each to mining and agriculture.

  By example, this study found that more than 4,000 acres that were wetlands in 1979 were converted to urban development by 1999, an amount of wetland loss much higher than permitting records would indicate. By selecting specific instances of these conversions and tracking the parcels through intermediate period aerial photographs, one could learn how these wetlands were converted. There are a number of possibilities:
    - Permitted wetland loss without effective offsetting mitigation
    - Impacts occurred in isolated wetlands before March 31, 1987
    - Delayed effect of drainage not previously regulated
    - Illegal activities not detected by enforcement
    - Use of the agricultural exemption before urban development

  These possibilities, and perhaps others, should be explored on a sample of conversion sites to determine the nature of this regulatory gap.

  Losses to mining and agriculture should be examined to determine whether exemptions have been properly applied and reclamation has been efficacious.

- FDEP, in coordination with SWFWMD, should audit the efficacy of existing regulated wetland mitigation.

  Large wetland losses to highly regulated land uses beg the question of mitigation efficacy. Mitigation is required to avoid cumulative impacts, yet there were over 4000 acres of wetlands lost to urban land uses in the 20 years between 1979 and 1999. This recommendation is to verify the efficacy of a sample of wetland mitigation projects that have been built and determined complete by the permitting agencies.

- FDEP, in conjunction with SWFWMD, should audit changes in wetland acreage on agricultural production lands to ascertain the rate and cause of change in wetland acreage and determine opportunities to work with agricultural operators to minimize the loss and alterations to wetlands and improve base flows from wetlands.

  By auditing a sample of agricultural lands using successive aerial photographs over two decades, one could test some of the macro-scale observations in the CIS about trends in agricultural drainage. A research approach (i.e., non-enforcement) to interview operators about the costs and benefits of maintaining drainage may discover opportunities to store more water on agricultural land by modifying management practices. This could lead to opportunities for agricultural landowners to realize income by meeting the base flow needs for water supply.

- FDEP, in conjunction with SWFWMD, should audit losses in stream channels to understand the dynamics that have allowed 343 miles of loss during a period of increasing regulation.

  The CIS does not reveal the current rate of stream loss, but comparisons of aerial photographs between 1999 and the present would help quantify the currency of the problem. The audit should be carefully designed to sample specific stream segments that have been lost to determine the cause(s) of their demise and possible approaches to stem these losses. Possible causes of stream loss include:
  - Ineffective mitigation of permitted stream alterations
  - Illegal activities not detected by enforcement
  - Reductions in surficial aquifer by drainage
  - Unintended impacts from ditching and channelization authorized by exemptions

Protecting and Enhancing Public Water Supply

- Pursue mineralization abatement through QWIP, Back-Plugging Funding Assistance and FARMS to improve the quality of surface water for both aquatic life and water supply.

  This study found that increased mineralization was widespread throughout the middle and lower Peace River watershed, and that the impacts are both to aquatic life and water supply. This recommendation is to pursue mineralization abatement throughout the watershed, not just in the areas were critical water quality problems have been manifested.

- Reinforce the need for water use permit applicants to provide reasonable assurance that water quality standards will be maintained in natural waters affected by the water use.

  While there is ample statutory authorization for considering water quality impacts in the issuance of the water use permit, updating the Basis of Review to reinforce this requirement would be a public service. Applicants rely on water use permits to support their capital investments, and the additional cost to address unexpected water quality concerns can be a hardship.

Phosphate Industry Regulation and Reclamation

- Combine Conceptual Reclamation Plans with Environmental Resource Permits to ensure that wetland mitigation required under the Environmental Resource Permit review is implemented in the best way for long-term resource management.

  Phosphate regulations for reclamation of wetlands are currently overlapping and conflicting with the beneficial application of ERP mitigation requirements. Because both sets of regulations address the same loss of wetlands, they should be combined and streamlined to be more effective and straight-forward. The ERP standards for mitigation were adopted in 1995 and apply to all activities statewide. They should be adopted in place of reclamation rules originally adopted in 1987 and updated in 2006.

- Develop land planning options to combine mine permits with post-mining land use approvals.

  Decisions made in the Conceptual Reclamation and Environmental Resource Permits affect the options for land use after mining. The post-mining economic viability of communities, the quality and quantity of waters, and the possibilities to create beneficial improvements during the reclamation process should be reviewed by all affected parties before the mining is approved. Currently, the Development of Regional Impact review addresses many of these issues, but parties outside of affected regional planning councils are not enfranchised. This recommendation is for a soup-to-nuts review process that addresses mining and post-mining land use issues.

- Audit FDEP-released mandatory wetland reclamation sites to understand the apparent discrepancy between photo-interpretations and reclamation records (aerial photography is dated 1999, while reclamation records are current through 2006, a seven-year difference).

  This study identified a gap between the records of completed wetland reclamation and the identification of such from the aerial photographs. There are definite limitations to aerial photo-interpretation, for sure, but the size of the wetland losses in mined watersheds was much larger than expected. This recommendation is for an audit of randomly selected "signed-off" wetland reclamation sites to determine how they compare with the photo-interpretation, as well as whether they represent the quality of wetlands expected from the program.

- Sunrise the Nonmandatory Reclamation Program to allow additional applications for the donation, acquisition, and/or reclamation of Nonmandatory parcels.

  As this study documents, there are unfunded projects in the Nonmandatory Reclamation Program totaling approximately 8,200 acres. According to the FDEP, each of these projects has the potential to improve surface water bodies of regional importance.

- Accept additional applications for parcels whose reclamation is in the public interest to provide significant benefits to surface water bodies supplying water for environmental and public purposes.

  Changed circumstances, including land values, insights from this study, and revised population projections justify re-opening the application process with a revised set of criteria to address long-term concerns about water supply, habitat connectivity, and sustainable tax base.

- Identify Nonmandatory parcels within the Integrated Habitat Network (IHN), and develop a plan for the strategic acquisition of critical parcels.

  Because native habitats are disrupted over large areas by phosphate mining operations, the Integrated Habitat Network is especially important in areas that have been mined. The Nonmandatory Reclamation Program is not specific to the restoration of land for habitat, but where funds from the program can be applied to the IHN, the FDEP needs to acquire strategic parcels to complete critical linkages.

- Identify sites whose current conditions have potential for improving Peace River watershed hydrology.

  The CIS documents large historical losses in wetlands and stream segments, which have adverse effects on the ability of the Peace River to sustain natural communities and to be a regional water supply. Fortunately, many of these losses are reversible, and this recommendation is to address opportunities to restore hydrology on parcels mined before July 1, 1975.

- Fund the Nonmandatory Reclamation Program to meet current and future needs.

  The funding formula for a sunrised Nonmandatory Reclamation Program should be developed to meet the goals in the above recommendations. New criteria for eligibility will likely be needed to achieve these goals through the Program. The Program addresses only issues related to the lack of reclamation from phosphate mining occurring before July 1, 1975.

Restoring Wetlands to Increase Low Flows

- Identify and prioritize opportunities to restore hydrology (reverse drainage) and re-connect wetlands to the Peace River.

  Over 136,000 acres of wetlands – ten percent of the watershed -- have been lost in the Peace River watershed since the 1940s. The majority of this loss has been from conversion of wetlands to improved pasture, intensive agriculture, or native uplands by the construction of drainage works to lower water tables and reduce the periods of inundation. This loss represents a corresponding loss in the surficial aquifer storage that feeds the base flow of the Peace River. Identifying and prioritizing opportunities to restore a more natural hydrology to these wetlands would be a first step to protect and enhance the long-term base flow of the Peace River. In phosphate mined areas, the opportunity may be to re-connect reclaimed wetlands to the river to provide an extended base flow.

- Create regulatory incentives for the restoration of drained wetlands and non-regulatory incentives to achieve Best Management Practices through cost-share programs.

  Restoring drained wetlands throughout the basin would increase base flows, creating a more natural flow regime and providing more days of "safe yield" for water supply from the Peace River. Most of the drained wetlands are on lands in agricultural production, which rely on permits for irrigation water. This recommendation is to explore ways to combine the goals of Water Use Permitting and Environmental Resource Permitting by providing a regulatory incentive in Water Use Permitting for restoration of drained wetlands. In addition, non-regulatory incentives should be explored to achieve Best Management Practices that promote natural flow regimes and improved water quality.

- Acquire flowage easements and fund restoration of wetland hydrology on private lands.

  This study identified unexpectedly high losses of wetlands both since the 1940s and between 1979 and 1999. These losses were part of a widespread historic conversion of native land to agricultural use. Some evidence in the pattern of reversion of drained wetlands indicates that the economics of drainage that spurred the earlier conversions through construction of drainage works may now be different. If this is the case, there may be an opportunity to work with landowners to acquire flowage easements and reverse drainage works to store more water on agricultural lands. A strictly voluntary program could provide ancillary income to cooperating landowners.

- Develop alternatives to address the drainage rights of landowners adjacent to wetland restoration projects.

  For land that has been legally drained, landowners enjoy a right to the benefits of that drainage. Therefore, restoration of wetlands cannot impair the drainage on adjacent properties. Some restoration projects can become too costly or be deemed ineffective because of the need to protect the drainage rights on neighboring land. This recommendation is to limit the application of those rights to uplands, so that restoration projects could cause *de minimis* changes to drainage patterns on neighboring property. *De minimis* for agricultural land would be defined as any change that would not cause the extent of wetlands on the neighboring property to expand. Typically, this is the temporary storage of storm water in existing wetlands following exceptionally heavy rain events.

- Develop specific engineering standards for ERP permits to restore wetlands.

  Regulatory agencies typically employ single-event models to predict the changes in runoff after development. These models are convenient and useful in the urban environment for protecting the public from unwanted flooding. This recommendation is to have a continuous model developed, which would be applicable to restoration projects for which the single-event models are inadequate.

Floodplain Protection

- Develop criteria for the protection of uplands within the 100-year floodplain based on the size of the stream protected, the width of wetlands adjacent to the stream, the cover type of the uplands, and the land use context.

  Buffers serve a number of beneficial uses to adjacent streams and wetlands. Protection of uplands within the 100-year floodplain would be generally beneficial to water quality, flood control, and wildlife, but the exact prescription for these upland buffers needs to be developed. Should the protection of upland buffers be just from mining or development, or should it extend to other less intensive uses? What about uplands that have already been converted to pasture? Should the amount and width of upland buffer protection be defined solely by the theoretical 100-year flood level, or by other characteristics like slope, soil type, or vegetation that can be measured on a site? Should the width of an upland buffer reflect the use being buffered from the wetland or stream, i.e., should an intensive land use have more buffer than a less intensive land use? These questions should be raised and resolved as criteria for upland buffers.

- Work with Florida Forever program to apply severance tax funds to floodplain acquisition.

Under the current allocation of severance tax revenues, the CARL program receives $10 million annually. Most of this revenue is generated by mining within the Peace River watershed, yet only a small amount of these funds are retuned to the watershed as land acquisition. This recommendation is to find a way to return more severance tax money to the Peace River watershed through CARL program acquisitions.

Potential Water Quality/Habitat Related Studies

- FDEP and SWFWMD should conduct a synoptic study of benthic invertebrate and fish populations in the following representative watershed stream systems to compare and contrast the influences of highly mineralized ground water discharges to the biological communities of the receiving streams.

  - Charlie Creek – low/moderate agricultural influences
  - Payne Creek – phosphate and power facility influences
  - Horse Creek – low mining and moderate agricultural influences
  - Prairie, Shell and Joshua Creeks – large agricultural influences

  The results of this investigation should be then used to re-evaluate current Class III total dissolved solids and conductivity standards to more fully protect natural in-stream habitat.

- The Florida Fish and Wildlife Conservation Commission (FWC), in cooperation with FDEP and SWFWMD, should update the document: "Habitat reclamation guidelines: A series of recommendations for fish and wildlife habitat enhancement on phosphate mined land and other disturbed sites.

- A synoptic watershed-wide study should be conducted to establish baseline in-stream toxic pollutant levels in sediments (trace metals, herbicides, pesticides, etc.) against which to assess potential current and future risks.

Development of Additional Hydrologic and Other Data Sources

The Peace River Cumulative Impacts Study included extensive searches and reviews of available data, records, and literature. During the course of this effort, certain data gaps became apparent. Given the comprehensive nature the study, these identified historic and existing data gaps probably cannot be significantly filled or reconstructed by additional research and analysis. The following recommendations are suggested towards improving the current level of understanding of the Peace River watershed hydrology for future analysis.

Land Use/Land Cover Mapping

- It is recommended that FDEP, SWFWMD, and the phosphate mining industry work together to develop comprehensive detailed GIS information of historic and current active and post-mining land uses.

- SWFWMD should develop land use layers with greater detailed FLUCCS coding in areas of specific identified impacts such as basins with high discharges of mineralized ground water.

Hydrologic Mapping

- Develop better mapping of control structures including elevations and operational details.

- Create enhanced mapping of hydrologic features in active and post-mining areas as well as areas of intense agriculture (e.g., ditches, canals, control structures, etc.).

Rainfall

- Develop better determinations to quantify the quantity and distribution of rainfall across the Peace River watershed. National Weather Service watershed rain gages have the longest historical records, but the information from these and SWFWMD rain gage data, as well as NEXRAD derived rainfall estimates, needs to be better integrated to determine better basin specific seasonal rainfall estimates.

- Investigate augmentations from irrigation return flows, septic system drainfields, and reclaimed water use. A significant portion of extracted ground water (and surface water) is returned to the hydrologic system in the form of excess irrigation, etc. Little or no actual data is available, and hydrologic analyses depend on estimated fractions of return flow.

Evapotranspiration

- Development of crop and land use coefficients specific to FLUCCS categories in the Peace River watershed (e.g., different mining activities, native vegetation types, agricultural practices, and urban land uses).

Karst Losses

- Continue SWFWMD support for USGS investigations quantifying karst losses in the Peace River channel between Bartow and Fort Meade.

- Quantify additional karst losses outside of the river channel (e.g., leakage through karst lakes and through other forms of epikarst).

- Field investigations to better understand the character of the karst sinks and conduits (i.e., depth, drainage capacity, and relationship to the intermediate aquifer system and the Upper Floridan aquifer system).

Base Flow

- Conduct a more detailed investigation of basin base flows comparing the results from hydrograph separation methods with evidence gathered from field investigations using physical and geochemical methods.

Urban Area Hydrology

- The hydrology and modifications from the previous natural conditions in the urban areas of the Peace River watershed are largely unknown. As the Peace River watershed undergoes accelerated urbanization, an understanding of the hydrologic effects of such development becomes increasingly important.

- Development of hydrological coefficients specific for different urban land use categories (e.g., low-density residential and industrial) in different areas of the watershed based on topography and soils.

Irrigation

- Develop details on irrigation methods utilized in urban and agricultural areas in the watershed with specifics on related crop coefficients and application volumes and times.

Water Use

- Better quantify ground water pumping rates enabling enhanced spatial and temporal resolution.

- Continue to examine impacts of land use changes on runoff and base flow contributions to the Peace River with specific emphasis on wetlands loss or structural alterations to wetland and lake flows. The fully integrated surface water/ground water flow model of the watershed currently under development by SWFWMD, along with other research efforts, should be used to better quantify these impacts.

6.0 Relevant Literature

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