Offset Banking – A Way Ahead for Controlling Nonpoint Source Pollution in Urban Areas in Georgia (Draft)

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Executive Summary

Nonpoint source discharges remain the major cause of non-attainment of water quality goals in urban areas within Georgia. Hence controlling nonpoint source discharges will be a critical part of achieving water quality goals within urban areas. Efforts to reduce nonpoint discharges are expected to intensify with implementation of Total Maximum Daily Loads (TMDLs) and changes to National Pollutant Discharge Elimination Program (NPDES) permits.

Given the need to reduce existing nonpoint source discharges in many urban counties within Georgia, it is likely that regulatory authorities will become more circumspect about approving new developments with negative environmental impacts. Thus, given current policies, conflicts between environmental and developmental goals are expected to increase in future years.

In this working paper we discuss the use of *Offset Banking*, which is flexible mechanism that can facilitate development, but with no net environmental impact. Indeed, it is possible to design an Offset Banking program that results in net environmental improvements from additional development. As well as benefits to the environment, offset banking can provide benefits to developers by enabling further development to occur, reducing overall nonpoint source discharge control costs and reducing uncertainty within the development process.

Offset Banking is conceptually similar to wetland mitigation banking, except that it focuses on the control of nonpoint source discharges. In an Offset Banking program, an "Offset Bank" undertakes a series of projects to reduce nonpoint source discharges. In return for undertaking these projects, the bank receives offset credits. When new developments create net environmental impacts, they must offset these impacts by purchasing credits from an offset bank with credits available from a nearby project. In this way, development can proceed without there being an overall negative impact on environmental quality, and potentially an environmental improvement if developers are required to purchase more credits than the pollution generated. Offset Banking thus represents a pragmatic solution to future conflicts between developmental and environmental goals within urban areas.

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1. Conflicts between Achieving Water Quality Goals and Development: A Motivation for the Use of Offset Banking

Nonpoint source pollution is currently the main cause of violations of water quality goals in Georgia. Examples include litter, fertilizer, metals, oils, pesticides, bacteria and other pollutants. Sources of nonpoint source pollution include agricultural and urban activities, such as run-off from farms, stock having access to streams, streambank erosion, septic tanks, smaller stormwater outlets, run-off from building sites and atmospheric deposition. While efforts have been made to control point source discharges, nonpoint source discharges remain problematic. Almost 64% of non-attainment is due to nonpoint sources, and this figure would be higher if urban runoff/stormwater were included (see Table 1). It is apparent that achieving water quality goals will require control of nonpoint source discharges. However, nonpoint sources are more difficult to control than point source discharges. They are also more difficult to monitor, and enforcement of controls is harder because of their diffuse nature.

Table 1: Potential Sources of Non-attainment of Designated Uses – Rivers and Streams

	Miles of rivers/stream where there is non-attainment	
Industrial Point	18	0.3%
Municipal Point	74	1.3%
Hydropower/Habitat (Dam Release)	17	0.3%
Natural Sources	433	7.5%
Urban Runoff/Stormwater	1537	26.7%
Industrial Nonpoint	169	2.9%
Nonpoint Source	3518	61.0%
Total	5766	

Source: Georgia Department of Natural Resources (2000), p.3-38

The impetus for controlling nonpoint source discharges is likely to increase in future years. The setting of Total Maximum Daily Loads (TMDLs) by the Environmental Policy Division (EPD) will make explicit nonpoint source loads that will allow

attainment of water quality goals prescribed under the Clean Water Act. As part of the TMDL process, implementation plans will need to be developed within 12 months of the setting of the TMDL so that water quality goals will be achieved. Within Georgia, the EPD has contracted with all of the Regional Development Centers (RDCs) to develop implementation plans. These implementation plans are reliant primarily on funding through state and federal grants, which must be applied for and are uncertain. If TMDLs are not achieved, the EPD has the regulatory authority to restrict new point and nonpoint source developments. Federal Court rulings that the EPA enforce the Clean Water Act will mean that eventually these implementation plans will have to be acted upon (Environmental Reporter 1996).

The requirement by the EPA to include stormwater outlets within the NPDES program will also provide motivation for nonpoint source control. Under Phase I of the Storm Water Program, stormwater outlets in towns of more than 10,000 people are considered to be point sources and receive permits, similar to other point sources. Phase II of the Program will become operational in March 2003, and requires the issuing of permits for certain regulated small municipal stormwater systems, and also for construction activity disturbing between one to five acres of land. The full impacts of these policy changes will be felt when stormwater authorities are required to make the requisite changes necessary to achieve water quality goals. In part, this could involve installing structural stormwater controls such as sedimentation ponds, infiltration basins and trenches, swales and other control devices. However, it may also necessitate costly retrofitting at previously unpermitted nonpoint sources. It could be expected that further development would be restricted or delayed in areas where violations of stormwater permits are occurring.

Thus the TMDL process, in conjunction with the issuing of NPDES permits for stormwater outlets, is likely to lead to pressure to restrict development in certain parts of Georgia. This would be most pronounced in urban areas, such as in counties that drain into the Chattahoochee River. However, at the same time these counties are some of the fastest growing in the United States. Thus it can be expected that conflicts between

environmental conservation and development will increasingly occur in the future because of these water issues unless new policy initiatives are developed.

One approach to dealing with this potential conflict between goals is to establish policies that allow development to occur but in an environmentally sustainable way. That is, enabling development to proceed provided that there are no *net* environmental impacts.

At the heart of this proposal is the concept of "offsets". An offset occurs when a developer "offsets" impacts on the development site, by undertaking equivalent environmental improvements at a second, nearby, site. The developer may undertake offsets or a third party who specializes in undertaking offset contracts may complete them. Offsets may also be designed so that they achieve net-environmental improvements. This would happen if a developer were required to achieve larger environmental improvements than any impacts they have caused. Typically offsets are undertaken and approved prior to causing development impacts so that there are no temporal effects on environmental quality (US Corps of Engineers et al 1995).

The concept of using offsets to manage development pressures and environmental impacts has been advocated in other contexts. Perhaps its best-known application is wetland mitigation banking (US Corps of Engineers et al 1995). Here, if new developments cause wetland impacts and it is not possible to mitigate these impacts on-site, then wetland offsets at secondary sites may be approved. More recently, offsets have been used for mitigating streambank impacts in Georgia and elsewhere[1]. Other applications have also occurred, such as flood storage offsets in Louisville, Kentucky along the Salt and Ohio Rivers, and in Albany, Georgia and Florida. Thus there is increasing use of offset programs to facilitate environmentally friendly development.

The use of offsets could provide a practical solution to the tension caused by the need to achieve water quality goals and the pressure for increased development in the Atlanta region and other urban areas within Georgia. For instance, along the Chattahoochee

[1] www.sas.usace.army.mil/permit

River, the major causes of violations of water quality goals are fecal coliform bacteria and BOD. New developments can be assessed for contributions to these two pollutants, and required to offset their impacts. They would offset their impacts through purchasing credits from privately and/or publicly owned offset banks before creating any impacts. Done properly there should be no net negative environmental effect and, if desired, environmental improvements could be achieved if developers are required to purchase more credits than the pollution generated. In addition, the use of offsets may generate substantial cost savings for businesses compared to having to fully mitigate any impacts on-site. Providing a straightforward method of satisfying environmental requirements will also reduce risk and encourage investment within urban areas in Georgia.

The use of consolidated offset banks rather than disparate site-specific remediation efforts could have a number of advantages, as suggested by the US Corps of Engineers et al (1995) in the context of wetland mitigation:

- *It may be more advantageous for maintaining the integrity of the aquatic ecosystem to consolidate compensatory mitigation into a single large parcel or contiguous parcels when ecologically appropriate;*

- *Establishment of a mitigation bank can bring together financial resources, planning and scientific expertise not practicable to many project-specific compensatory mitigation proposals…*

- *Use of mitigation banks may reduce permit-processing times and provide more cost-effective compensatory mitigation opportunities for projects that qualify.*

- *Consolidation of compensatory mitigation within a mitigation bank increases the efficiency of limited agency resources in the review and compliance of monitoring projects…*

Thus there are strong motivations for considering the use of offset banking to achieve water quality goals and manage development pressures in Georgia. In this working paper, we next consider economic incentive programs that can be used to cost-effectively control nonpoint source discharges more broadly. Then in Section 3, consider some practical issues involved in setting up an offset program, and in Section 4 we describe the necessary elements of an offset banking program to control nonpoint source discharges. Conclusions are offered in Section 5.

2. Economic Incentive Programs for Cost-Effective Achievement of Water Quality Goals

Achievement of environmental quality standards through command and control approaches – such as requirements for use of technology standards and that ambient discharge limits are met – can be unnecessarily costly. Experience with flexible economic approaches has demonstrated that standards can sometimes be achieved at a much lower cost. One of the best examples of this is the US Sulfur Dioxide Emissions Trading Program where cost savings of between $225-375 million were achieved in 1995 (Schmalensee et al 2000). Cost savings of at least this magnitude are anticipated from using innovative approaches to improve water quality. The EPA (2001) estimated that flexible approaches to improving water quality as part of implementing TMDLs could save $900m annually compared to the least flexible approach.

Tradable permit programs are not the only economic incentive program available for controlling water pollution, though there has been considerable interest in them (EPA 1996, Ribaudo, Horan and Smith 1999). Currently within the United States there are 37 watershed trading or offset programs in operation or under development (Environomics 1999).

Tradable Permit Programs

Watershed trading is a broad term that is often used to describe a fairly wide variety of economic incentives. This includes *point source trading* which involves trading between point sources of discharge *credits*. Point sources who find it expensive to reduce discharges will buy credits as long as it is cheaper for them to do so than implement more stringent controls. They will thus save money. In contrast, polluters who find it relatively cheap to reduce discharges will undertake additional controls and sell the credits they obtain by doing so and make money. In this way, trading encourages discharges to be controlled by point sources who can do so at least cost (Baumol and Oates 1998). In addition, the aggregate load is limited by the total number of permits available to trade, thus environmental goals are met.

In a point source trading program, the load that a source is allowed to discharge is denominated in credits – eg 300 lbs of phosphorus per year.

These credits can be bought and sold by point sources

There are only a couple of point source or point-nonpoint[2] source trading programs in the United States and overseas that have been successful at generating large amounts of trading. Perhaps the best two examples are the Grassland Farmers Trading program in California and the Hunter River Salinity Trading program in Australia (Austin 2001, NSW EPA 2000). There are, however, many other point source trading programs that have not generated any trades (see Environomics 1999). This raises questions about the unique features of the Californian and Australian programs that led to the creation of successful markets. While there are probably a number of possible explanations, it appears that there were two main factors that led to their success. The first is the nature of the pollutant traded. In the California program selenium was traded, while in the Australian program salinity was traded. Both of these pollutants are conservative, meaning that they will remain in a river over long period of time . Secondly, the point sources in these trading programs have reasonable control over the timing and extent of

[2] In a point-nonpoint source trading program, point sources can earn credits by choosing to reduce nearby nonpoint source discharges. In some contexts this may be a more cost-effective form of control that further reducing their own discharges or purchasing credits from other point sources.

their discharges of these pollutants. Because of these differences, credits are based on daily discharge loads. Hence there is scope for day to day trading of discharge rights in these programs. However, many of the pollutants causing violations of water quality standards in Georgia – such as BOD, fecal coliforms and sediment – do not have these characteristics. While trading programs can be developed for these pollutants, the evidence is that it can be more difficult to generate effective markets.

Offset Contracting

Offset contracting is a second economic incentive program that has greater potential for use in Georgia. While it is conceptually different to the trading programs just discussed, it is often considered to be a form of trading (Woodward, Kaiser and Wicks forthcoming). As discussed in Section 1, the basic idea of offset contracting is that if a source wishes to either create new loads or increase existing loads it must first offset its increase by reductions in loadings elsewhere. For instance, the developers of a new golf course might be required to fund best management practices in nearby agricultural areas in addition to on-site best management practices. Or a new housing development might only be approved if, as part of the development, septic tanks in an existing development are sewered (see Boxes 3 and 4 for examples of this type of offsetting).

Offset programs can be established so that development has no net environmental impacts, or so that development leads to net environmental improvements. In the enabling legislation it is possible to require an offset ratio greater than one, so that sources have to more than offset their planned increase in loadings. This can be used to achieve additional environmental improvements and to hedge against any uncertainties regarding water quality impacts.

Offset contracts can be implemented via bilateral negotiations between stakeholders (ie where developers directly contract with owners of potential mitigation sites), or through privately or publicly owned offset banks. An offset bank is not a bank in the usual sense. Rather an offset bank involves the completion of one or more projects in which environmental remediation works are undertaken. By completing these works, offset

banks earn "credits" which can then be sold to developers who are creating net-impacts on environmental quality.

In the case of wetland mitigation and streambank mitigation banking, offset banks are run by either private business, non-profit organizations or, in some states, by government organizations. The majority of banks are privately run, which is the case in Georgia (ELI, 2001). For other offset programs, such as the Dillion Reservoir program (Box 1), bilateral negotiation has been used. In 2001, there were estimated to be over 200 operational wetland mitigation banks in the USA, and over 100 awaiting regulatory approval (ELI, 2001). The advantage of either setting up a private or a government program to oversee implementation of offsets is that it would greatly reduce the transaction costs of using offsets. It has been found that increasing transaction costs will reduce the propensity of sources to use incentive programs such as offset contracts (Hahn and Hester 1989).

Box 1: Dillon Reservoir, Colorado

Two examples of the use of offsets have occurred in the Dillon Reservoir. In the first, the Frisco Sanitation District built a series of concrete vaults to drain a section of the town and reduce phosphorus loadings. The District then received credits that were expected to be used to offset the increased phosphorus runoff from a planned golf course.

In the second example, a stream was to be diverted by Denver Water Board into Dillon Reservoir. This was expected to increase phosphorus loads by about 200 pounds p.a.. To partly offset this increase, the sewerage authority agreed to achieve equivalent reductions elsewhere in the basin. A creek with high phosphorus loadings was identified, and a dam was constructed to filter water entering the reservoir when flows were low. Other projects are also expected to be undertaken until the increased load is fully offset.

Source: Morrison and Izmir (1994)

Offset contracts have also been used to provide flexibility for point sources in achieving water quality standards. For example, a malting company in Minnesota (a point source) that was increasing its loading was allowed to use offset contracts to reduce nonpoint source discharges (see Box 2: the Rahr Malting Plant). Examples also exist of publicly owned treatment works (POTWs) using offset contracts with nonpoint sources to more

cheaply achieve water quality standards. These plants had already implemented technology-based requirements, but further reductions were needed to attain water quality standards. In rural areas where there is a scarcity of funds for water quality goals and greater competition for expenditure in other priority areas this may prove to be a sensible alternative (see Box 3: Boulder Creek Offset Program). The recently released EPA policy on watershed trading is supportive of using offset contracts in this way (EPA 2002).

Box 2: Rahr Malting Company Offset

The Rahr Malting Company is located on the Minnesota River. Along the lower 25 miles of the river the TMDL for BOD is fully allocated. The Rahr Malting Plant was treated as a new point source when it redirected its discharges into its own wastewater treatment plant instead of the local POTW. A stringent discharge limit plus an offset clause was written into the facilities NPDES permit.

In exchange for increasing BOD discharges, the plant has financed upstream reductions in phosphorus nonpoint source discharges. Rahr has established a trust fund to oversee the offsets. The trust fund was initially established at $200,000 and will be augmented by $5,000 per year over the life of the offset. A board that includes citizens, state officials and company representatives oversees the trust.

An offset ratio of 2:1 was used to allow for differences between point and nonpoint source discharges, plus an additional 8:1 ratio to allow for control of phosphorus rather than BOD. This later ratio reflects a scientific assessment of the relative impacts on chlorophyll from phosphorus runoff and BOD discharge. The Rahr Plant has now fully offset 150 pounds of BOD per day, and has exceeded the required offset by 62 pounds per day.

Source: Environomics (1999), Klang (2000)

Box 3: Boulder Creek Offset Program

The City of Boulder has implemented a program in which nonpoint source discharges are controlled in place of improvements to its Publicly Owned Treatment Works (POTW). Capital improvements to the POTW would be costly, and it was found that it would cheaper to undertake more modest improvements to the POTW plus a series of measures aimed to reduce nonpoint source discharges. This included streambank stabilization, riparian corridor improvements, and rerouting irrigation return flows through wetlands.

The program was implemented in 1990. Between 1996 and 1999 the city spent $1.4 million on the program, with cost savings estimated to be between $1.6 and $5.6 million.

Source: Environomics (1999)

3. Practical Issues Involved in Establishing an Offsets Program

When considering an incentive program such as the use of offset contracting, a number of issues naturally arise about the practicability of such a program. For instance, is it possible to estimate loads at such a detailed level, and which nonpoint source pollutants should be the focus of the program? Other relevant issues pertain to the possibility of localized impacts, temporal impacts, financial and/or management failure and whether banks should be privately or publicly run. These issues are the focus of this section.

3.1 Estimating nonpoint source loads

The use of offset programs is predicated on the ability of regulators or their agents to estimate loadings from potentially fairly small development sites. In the past this has been difficult, and efforts to estimate loads have relied on the use of proxies such as the area of impervious surface. However, improved technology means that loads can be estimated with greater accuracy. The EPA (2002), for instance, comments:

EPA recommends estimating pollutant loads, load reductions and credits from storm water runoff, other than agriculture, based on local hydrology and pollutant loading factors that relate land use patterns, percent imperviousness and controls or management practices in a watershed to per acre pollutant loads…This is done by determining pollutant-specific loading factors for each land use type in the watershed or area where trading occurs, calculating the average annual storm water runoff volume from pervious and impervious area for each combination of land use type and control and management practices; and, computing the average total annual load for the watershed or trading area by the sum of all land use loading factors multiplied by the area for each land use type.

Several counties within Georgia (eg Clayton, Gwinnett, Hall, Rockdale and Forsyth) use spreadsheet-based tools that calculate total suspended solids loads for new developments. For example, Clayton County[3] uses the WISE model to assess Total Suspended Solids (TSS) loadings of new developments, developed by CH2M Hill. This model identifies four different land uses on each site: impervious area, disturbed pervious area, undisturbed upland area and undisturbed stream buffers. The spreadsheet estimates uncontrolled TSS loadings from each land type, and the reductions in loadings from installing various best management practices. The model provides estimates of the TSS load per acre.

3.2 Selecting Nonpoint Source Pollutants for an Offset Program

An important question that arises in the context of nonpoint source discharges, is which pollutants should be the focus of the offset program. In some watersheds there will only be a single pollutant of concern, which will simplify the selection process. Where there are multiple pollutants causing violations in water quality standards, all can be included within the program. For instance, suppose fecal coliform and TSS were both causing

[3] The spreadsheet model used by Clayton County (the WISE model) can be found at: http://www.ccwa1.com/Public/Public_Information/Developer%20Information/Developer_information.htm

violations of standards in a watershed. Then offset banks could earn credits by undertaking projects that reduce both of these pollutants. Credits earned would be specific to each pollutant. So if fecal coliform is reduced by X units, then B1 * X fecal coliform credits are earned (where B1 indicates the number of credits earned for a unit reduction in fecal coliform). Similarly, if TSS is reduced by Y units, then B2 * Y TSS credits would be earned. These credits could then be sold to developers creating net increases in either of these pollutants. An important reason for making credits pollutant-specific is that control works would be expected to have differential effects on the reduction of each pollutant. For instance, repair of septic tanks would be expected to cause a greater reduction in fecal coliforms than TSS, while the use of infiltration filters would cause a greater reduction in TSS. Thus, more careful definition of how credits are earned or used would be expected to lead to more effective control of problematic nonpoint source pollutants.

3.3 Controlling localized impacts

A concern with the use of any water-based incentive program is the possibility of localized impacts, which are sometimes called "hot spots". Hot spots occur when increases in discharges in a particular area cause violations of water quality standards. The EPA policy on watershed trading specifically prohibits any trading that would cause this sort of impact[4]:

> *Any use of pollutant reduction credits or allowances that would cause a localized impairment of existing or designated uses at the point of use, or that would exceed an in-stream target established under a TMDL is not acceptable.*

There are several ways of ensuring that localized impacts do not arise. First, the use of offsets can be limited to regional watersheds. Second, distance ratios can be used in the

[4] However, the EPA policy on watershed trading also states that trades that achieve no-net increase in loads of a pollutant will satisfy the anti-degradation requirements of the Clean Water Act.

calculation of credits. This means that as the distance between the offset bank's project site and the development increases, additional credits needs to be purchased. By making the offset more expensive, this creates an incentive to locate the development within closer proximity to offset bank sites. Third, all contracts should be subject to regulatory review. Contracts that may give rise to such impacts would not be approved.

3.4 Controlling Temporal Impacts

It is important to ensure that the timing of the completion of projects through an offset bank and the start of new developments does not lead to temporal reductions in environmental quality. To achieve this goal, offset projects must generally be completed prior to a development impact to ensure that there are no temporal environmental losses. However, there is normally a period of time between the completion of a control project and the final determination of success in terms of load reduction. It is common practice for wetland mitigation banks to allow the release of a proportion of credits (eg 10-30%) when the project has been completed, and with the remained released over a period of several years when certain success criteria have been met (eg US Corps of Engineers 2000). The advantage of staggering the release of credits in this way is that it reduces the likelihood of temporal impacts and provides greater certainty that environmental gains will be achieved.

3.5 Reducing the Risk of Bank Failure

When establishing an offset bank, the environmental benefits created through the bank need to be long term. Staggering the release of credits does provide some guarantee of the effectiveness of environmental controls. However, some controls also require long-term management, which is more likely to be the case for nonpoint source controls than with other offsets (eg wetland mitigation). When selling credits, banks need to ensure that adequate revenue is received to fund future operation and maintenance costs (US

Corps of Engineers et al 1995). Currently there is little evidence of bank failure, but if it became a concern legislation could be enacted requiring the establishment of annuities to provide for ongoing costs. Furthermore, for wetland mitigation banks it is common practice for offset banks to post performance bonds. These are effectively an insurance policy that would fund management of the bank's projects if the bank either failed to meet its management obligations or collapsed. Appropriate legal arrangements such as ownership of key resources and use of easements can provide additional safeguards (US Corps of Engineers et al 1995).

3.6 Private versus Public Management

A final issue of concern in establishing an offset program is whether the offset banks should be private or publicly owned, or both. Within Georgia, most wetland and streambank mitigation banks are currently privately owned. Little empirical analysis has been undertaken to determine the relative merits of different types of bank ownership. From a theoretical perspective, private ownership would deliver greater entrepreneurial effort and cost reduction, and potentially a competitive and efficient market outcome. However, public ownership would provide greater potential for economies of scale.

4. Elements of a Nonpoint Source Offset Contracting Program

The existence of functioning offset programs for wetlands and streambank mitigation provides guidance on the elements that would be required in a nonpoint source offset program. However, some differences would be expected because of the differences in the natural resource being protected. In this section we discuss the main elements of a nonpoint source offset banking program. This outline does not go into a lot of the detail that would be required in operationalizing such a program. However, examples of what would be required can be gleaned from existing offset programs such as wetland mitigation and streambank mitigation banking.

4.1 Enabling Legislation

The legal foundation for using offset contracts to control nonpoint source pollution can be inferred from several federal laws and policies (Woodward, Kaiser and Wicks forthcoming). While not explicitly prohibited in federal legislation, it is not explicitly authorized either. However, legal authority can be inferred from several sections of the Clean Water Act (33 U.S.C. § 1312, 1313), recently approved TMDL regulations (40 CFR part.9), and - most significantly - the EPA's "Proposed Water Quality Trading Policy" (EPA 2002). Legal authority also depends on state water law and policy, as well as local government ordinances. Stormwater management within Georgia occurs primarily through local government ordinances, but must be consistent with state government laws and policy. The establishment of offset banks in Georgia would most likely occur at a local government level.

The first requirement for establishing an offset banking program would be the development of an enabling statute. The statute would be required to prohibit development unless (1) all nonpoint source discharges are mitigated on site or (2) any new net discharges are offset through the purchase of offset credits.

The statute would also have to establish rules for the offset program. These rules would have to cover a number of areas (US Corps of Engineers et al 1995).

A. Rules must be established indicating the types of sites that are acceptable for establishing offset banks. This will most likely include degraded sites that are ecologically suitable, and where no plans currently exist to remediate the site. Banks can be sited on public or private lands (US Corps of Engineers et al 1995).

B. Rules need to be established for acceptable mitigation, performance, monitoring and maintenance. This would involve specifying the types of offset techniques that can be used, criteria for determining whether offsets have been

successful in controlling nonpoint source discharges, the amount of time monitoring is required, and maintenance standards.

C. Rules would also need to be established to ensure long-term site maintenance at offset sites. This could include the use of perpetual conservation easements or the purchase of land. Inclusion of bank funds in long-term trust funds and annuities could be used to provide funding for site maintenance. Financial guarantees could also be used to safeguard future funding.

D. Rules need to be established to govern market structure. This includes whether private operators are allowed to establish offset banks, or whether it will remain the domain of government agencies. Rules are needed to determine whether any or all of the credits can be sold prior to the completion and testing of the environmental gains achieved by a particular offset bank. Different rules for the latter may apply to government and privately owned offset banks. Finally, financial assurances or insurance requirements may be specified in the event that an offset bank partly or fully fails.

E. Pricing rules may also be established for government-managed banks.

F. Rules need to be established to specify the service area for offset banking. That is, the areas within which a development and the offset need to be located. This will typically be within regional watersheds or other more narrowly defined areas. Consideration will also need to be given to whether offsets will only be allowed within county boundaries or within watershed boundaries.

G. Rules may also be established detailing the calculation of trading ratios. Issues involved in establishing trading ratios are considered next.

4.2 Establishment of Trading Ratios

A critical aspect in the establishment of offset banking is the determination of the trading ratio. The trading ratio determines the number of credits that must be purchased from an offset bank to offset a particular environmental impact.

Trading ratios are typically a function of several factors. The first is desired environmental gain. If the objective of the program were to achieve net environmental improvements, then the ratio would be set at higher than 1:1. For instance, in existing point source and nonpoint source trading programs, it has been common for trading ratios to be set at 1.5:1 or 2:1.

The second factor is uncertainty about impacts. For instance, if there is uncertainty about the ability of the offset bank to properly offset environmental impacts, or there is uncertainty about how impacts at the development site may change over time. However, uncertainty should be reduced by requiring offsets occur prior to the development impact so that monitoring of environmental gains can be undertaken.

The third factor is distance between the development impact and offset. By applying a non-trivial distance related trading ratio, the likelihood of severe localized impacts will be reduced. It will encourage developers to seek offsets that are much closer to the development impact.

The final trading ratio will be calculated based on all of the above factors. While the method used for calculating the trading ratio will be pre-defined, the specific trading ratio for each development is likely to be variable.

4.3 Development of Offset Banks

Establishing an offset bank requires several steps. The US Corps of Engineers et al (1995) suggest several steps in developing mitigation banks. First, entrepreneurs proposing an offset bank discuss the appropriateness of a particular offset banking site with the regulatory authorities. Second, the entrepreneurs submit a prospectus that outlines the objectives of the bank, how it will be established and operated. This will provide the opportunity for feedback prior to the development of an offset banking instrument.

An offset banking instrument is a written agreement that formalizes the establishment of an offset bank. The instrument would be prepared by the bank proponent and would be expected to include information about (see US Corps of Engineers 2002):

- Ownership of bank lands
- Bank goals and objectives
- Geographic service area
- Description of baseline conditions at the bank site
- Potential offsets
- Specific success criteria to determine when credits are available
- Assessment methodology or procedures for determining credits and debits (see next sub-section)
- Accounting procedures for tracking credits and debits
- A monitoring plan that identifies an evaluation schedule and reporting responsibilities
- Contingency and remedial actions and responsibilities
- Financial assurances if early credit withdrawal is proposed
- Method for determining trading ratios
- Provisions for long-term management and maintenance
- Method or instrument for the perpetual legally binding protection and preservation of the bank site

Approval of the banking instrument would be via a regulatory authority. For the wetlands mitigation program, this is through a committee of representatives of government agencies with regulatory responsibility for the site. Alternative regulatory oversight may be appropriate in Georgia.

4.4 Calculation of Impacts

For offset banking to be operational, formulas need to be developed for calculating the "debits" that will be assigned to impacts and the development site, and "credits" that will be assigned for environmental improvements at the offset banking site. At a development site, modifications such as increases in the area of impervious surface would be expected to increase nonpoint source discharges. However, on-site controls would reduce some of these impacts and would need to be factored into the formula. Similarly other factors that influence the extent of nonpoint source discharges such as distance from a creek or river, topography, soil type and vegetation may be relevant for calculating debits. As discussed in Section 3, spreadsheet programs could be developed so that debits for a particular development site can be quickly calculated given the key parameters at a site. This would also be helpful for developers so that they can understand how to design developments so that they have minimum impact on nonpoint source discharges, and to determine which controls can be cost-effectively implemented on-site. Similar formulas need to be developed for calculating credits, although the nature of these formulas will be different, since they will calculate the credits associated with works to improve environmental quality.

4.5 Modified Stormwater Permits

An important aspect of the use of offset banking will be the modification of existing stormwater permits for new developments. Currently, existing stormwater permits specify control works that must be implemented to meet permit conditions. For new

developments, new permits will need to be modified so that developers are required to offset, through the purchase of credits, any predicted net increase in discharges. The existing permitting program may also need to be changed so that smaller scale developments are also included under the umbrella of the offset program. The EPA's Proposed Water Quality Trading Policy is supportive of several different approaches for incorporating provisions for trading within NPDES permits[5].

4.6 Approval Process

The purchase of credits by developers will need to be governed by an approval process. Site inspections and submission of development and site plans would be expected to be part of this process and used to confirm debits. Accredited agents could be used to expedite this process for smaller developments. Web-based purchase of credits could be allowed for smaller developments, through a clearinghouse as occurs in other incentive programs currently operating. Larger developments could be overseen, and debit calculations and credit purchases approved directly by the regulator authority.

4.7 Public Comment

An important part of encouraging public acceptance for the use of an offset program will be to have public involvement early in the development of any offset program. Stakeholder involvement during key phases of bank development is essential. The Federal Guidance for the Establishment, Use and Operation of Mitigation Banks (US Corps of Engineers et al 1995) recommends that the public should be notified of and have the opportunity to comment on all bank proposals.

[5] Specifically, the Policy states that: "EPA supports several approaches for incorporating trading into point source NPDES permits: a) general conditions that allow trading to occur; b) the use of variable permit limits that may be adjusted up or down based on the quantity of credits generated or used; and/or, c) the use

5. Some Final Thoughts

Nonpoint source discharges are the major cause of violations of water quality goals in Georgia, and especially in urban areas. Pressure to achieve environmental improvements will be more pronounced because of the Federal Court requirements to meet the water quality objectives specified in the Clean Water Act and changes to the NPDES permits to include stormwater outlets. Achieving these goals in itself would be difficult; if the high growth rates experienced over the past 20-year in urban areas in Georgia continue, achieving water quality goals may well be impossible. Achieving water quality goals in the absence of any policy change may require controls on development.

Offset banking involving nonpoint source discharges provides an opportunity for allowing development and achieving environmental goals simultaneously. Another attractive feature of offset banking is that additional environmental improvements can be achieved, based solely on private funding. Similar offset programs have proven to be successful in several other contexts, including wetland mitigation, streambank mitigation and floodwater retention. They are intuitive and flexible programs that have generally been well accepted by the community. They have the advantage of being a cost-effective form of control, provide a practical means for allowing future development, and provide developers with a defined process for dealing with impacts associated with new developments. The use of centralized offset banks to oversee the creation and maintenance of nonpoint source controls may also prove to be environmentally more effective than the piecemeal installation of additional controls at individual sites. The use of offset banking would appears to have the potential to be a viable option for assisting in the management of nonpoint source discharges and development within urban areas in Georgia.

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of alternative permit limits or conditions that establish restrictions on the amount of a point source's pollution reduction obligation that can be achieved by the use of credits if trading occurs."

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