



Prospective Environmental Restoration/ Restoration Up Front: A Concept for an Incentive-Based Program to Increase Restoration Planning and Implementation in the United States

Ralph G Stahl Jr,^{*†} Ron Gouguet,[‡] Amanda DeSantis,[†] Jenny Liu,[†] and Michael Ammann[§]

[†]Corporate Remediation Group, Barley Mill Plaza, Building 19, Wilmington, Delaware 19805, USA

[‡]National Oceanic and Atmospheric Administration, Office of Response and Restoration Assessment and Restoration Division, 7600 Sand Point Way NE, Seattle, Washington 98115, USA

[§]Chevron Energy and Technology Company, 100 Chevron Way, Richmond, California 94802-0627, USA

(Received 25 May 2007; Accepted 11 September 2007)

ABSTRACT

This article describes a concept variously termed prospective environmental restoration, restoration up front, or restoration banking. Briefly, the concept centers on the ability of an entity, public or private, to gain durable credits for undertaking proactive restoration activities. Once obtained, these credits can be applied to an existing liability, held in the event of a future liability, or traded or sold to others that might have need for the credits. In the case of a natural resource damage claim or response action, possessing or applying the credits does not negate the need for responsible entities to clean up spills or releases of hazardous substances or oil or to address their clean-up requirements under applicable federal and state statutes. Concepts similar to prospective environmental restoration/restoration up front include wetlands mitigation banking, conservation habitat banking, and emissions trading. Much of the concept and details provided herein stem from the practice of natural resource damage assessment, although that is not the sole driver for the concept. The concept could also apply where the credits could be used to offset other environmental liabilities, for example, to provide habitat mitigation where development is being planned. The authors believe that the concept, if widely applied, could reduce the time and costs associated with restoration and perhaps lead to an increase in voluntary restoration and conservation nationally. Currently, there are no state or federal regulations or policies that directly provide for this approach.

Keywords: Restoration Habitat conservation Framework

INTRODUCTION

In several recent forums (API/NOAA 2004, 2006; White House Conference 2005; Partnership for the Delaware Estuary 2007), there have been discussions about innovative mechanisms to increase the conservation of valuable ecological resources, services, and habitats across the United States. The purpose of these discussions has been to stimulate the development and communication of these mechanisms with a diversity of public and private groups, in hopes of moving from discussion to implementation—in effect, creating the mechanism to increase, tangibly, the restoration and conservation of valuable resources and habitats nationally. This dialog has been important to help refine the concept discussed herein, termed prospective environmental restoration/restoration up front or restoration banking. The concept is to provide the mechanism to obtain, buy, sell, or trade valuable ecological credits, in a cost-effective and flexible manner, thus increasing voluntary restoration and conservation opportunities and cooperation across the nation. Unfortunately, today, there is no national framework, guidance, or policy at the federal or state level that clearly details a process for this purpose. Yet, current examples exist where business models have been developed that provide a national forum and process for the banking, trading, and selling of

various environmental goods and services (USEPA et al. 1995; Stavins 2000; USFWS 2003; EC 2005). Those examples include wetland mitigation banks, as well as emissions trading, both of which will be discussed briefly to illustrate their relationship to the proposed concept of prospective environmental restoration/restoration up front.

PROSPECTIVE ENVIRONMENTAL RESTORATION/ RESTORATION UP FRONT

Relevance of natural resource damage assessment practice

In the case of prospective environmental restoration/restoration up front, some of the underlying economic and ecological foundations are found in the regulatory approach used in the quantification of ecological injury or harm, essentially the natural resource damage assessment (NRDA) process, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) and the Oil Pollution Act (OPA; USDOJ 1987a, 1987b; NOAA 1996). There have also been important discussions, albeit somewhat tangentially, of this topic in a number of publications in the field of natural resource and environmental economics or valuation (Bringham et al. 1995; Arrow et al. 2000). Some elements of the concept draw on those publications, but a full review of them and their linkage to the concept is beyond the scope of the current article. In addition, we do not wish to imply any direct equivalency between prospective environmental restoration and other state or

* To whom correspondence may be addressed:
ralph.g.stahl-jr@usa.dupont.com

Published on the Web 9/13/2007.

Table 1. Types of restoration as defined for the concept of prospective environmental restoration/restoration up front

Type	Description
A.	Improving an existing habitat—common in a regulatory context. Examples of improvements could include invasive species control, planting of nesting boxes for songbirds, increasing public access, etc.
B.	Creating a habitat—common for mitigation purposes, during the takings of habitats for public developments, such as highways or for residential housing developments. Examples include the creation of tidal and nontidal wetlands, alterations in physical structure, hydrology, etc. to foster voluntary native plant recolonization.
C.	Acquiring and protecting a habitat—common for conservation or environmental groups whose mission is to conserve habitats, greenspace, or valued natural resources. Examples include the purchase outright of the habitat or the property itself or the purchase of conservation easements that protect the status of the habitat or property in perpetuity.

federal programs discussed herein. However, the elements of prospective environmental restoration and other state or federal approaches do serve to illustrate the frequency and breadth of the national discourse on this topic, whether in publications or national environmental forums.

Under CERCLA and OPA, those held liable for the release or spill of hazardous substances or oil must 1st clean up those materials. In parallel or after clean up is completed, an NRDA is conducted by federal and state agencies and federally recognized Indian tribes who collectively are designated as trustees for the publicly owned or managed natural resources injured by the release or spill. During the NRDA process, injuries (harm) to valuable ecological resources and habitats, and the subsequent loss of the ecological or human services provided by them, are estimated and translated or scaled by the trustees into restoration projects. Responsible entities can undertake restoration projects, provide funding for restoration, including the acquisition of the equivalent resources and services, and in that way, discharge its liability and compensate the public for the natural resource service losses. Often, particularly in heavily urbanized or populated environments (watersheds), it is increasingly difficult to locate and secure potential areas where human uses or ecological-service flows might be improved through restoration projects. This issue is one of the most vexing because it can, for example, result in increased costs when responsible entities must compete for prospective restoration areas (properties or habitats) with land developers that might offer greater and faster compensation to land owners. This is one of the fundamental drivers for the concept proposed herein because responsible entities have found it increasingly difficult to secure land where restoration can be accomplished in a timely and cost-effective manner. One way to reduce those costs and expedite restoration projects is to have a mechanism whereby ecological credits could be readily estimated, obtained, remain durable, and later applied to resolving potential liabilities for natural resource damages or other environmental harms (Brody and Kealy 1995). Such a mechanism would afford responsible entities the time necessary to seek and secure land or habitats that would be amenable to restoration or enhancement, and undertake the restoration actions without the burden of competing with developers. There will still be the need to address any natural resource damage claim under applicable state and federal regulations, including ensuring a reasonable nexus between the injury and service loss, the restoration project, and the involvement of the relevant Trustee agencies throughout the process. Nevertheless, we believe that prospective environmental restora-

tion/restoration up front could be one mechanism that would provide a flexible, cost-effective process. Finally, we emphasize that in the case of a natural resource damage claim or response action, possessing or applying credits does not negate the need for the responsible entities to clean up spills or releases of hazardous substances or oil or to address their clean-up requirements under applicable federal and state statutes.

Variations of prospective environmental restoration/restoration up front

For the purposes of this article and to illustrate how the concept might apply, we have defined the 3 main types of possible restoration actions (Table 1) as A) the improvement of existing habitats, B) the creation of new habitats, and C) the acquisition and protection of existing habitats. These 3 actions are not the universe of possible actions, but do provide a broad spectrum of the possible actions one might undertake. In this case, 1 type of action may be preferred over another, depending on the habitats and resources that are available or under consideration, the physical or legal constraints (limits on the ability to undertake a particular action in a particular area), public needs, etc. As described in Table 2, each of these possible actions lends itself to at least 4 possible variations on the concept: 1) restoration aggregation/pooling, 2) prospective restoration, 3) investment restoration, and 4) restoration credits trading. As noted for the types of restoration actions, the action variation preferred will be site specific and potentially influenced by a myriad of factors. In some situations, restoration aggregation might be preferred when it is possible to pool a number of small projects in a way that will result in a larger, more ecologically beneficial, project. That may or may not involve the exchange of credits (for instance, each entity may fund an individual project directly). Likewise, prospective restoration may be applied when an entity, considering future issues and business risks, determines that there may be a future need to offset a presently unknown liability. In this situation, an entity that anticipates having a future need to offset a liability could undertake restoration prospectively to address its own liabilities. That restoration may or may not be large enough to address the liabilities of others. Investment restoration, on the other hand, is likely to be similar to the development of an ecological market, where an entity (possibly one that may not incur NRD liability) may enter into the business of undertaking restoration, gaining the credits, and either selling or trading them to others. That entity may or may not have the need to use the credits itself but anticipates that those credits will be needed by someone,

Table 2. Types of prospective restoration/restoration up front restoration-credits trading

1. Restoration aggregation/pooling	
	Plan/implement multiple site projects at once for efficiency
	Pool funds from multiple similar projects to allow construction of larger projects
	Takes advantage of timing
2. Prospective restoration (under a natural resource damages settlement, for example)	
	One large project (larger than needed by a single implementing entity) is constructed
	After injury and scales determined, credits apportioned contemporaneously at (natural resource damages) settlement among other members or entities involved
3. Investment restoration	
	Project is constructed before knowledge of scale of natural resource injury, but restoration type needed is well understood
	Restoration requirements from separate, future natural resource damages are satisfied from acres available in the restoration bank
4. Restoration credits trading	
	Project is constructed before knowledge of scale of injury, but restoration type needed is well understood
	Restoration requirements from separate, future natural resource damages are satisfied from acres available in the restoration credits bank
	Credits may be managed and sold to responsible parties or entities to satisfy specific habitat 'debit' requirements as part of natural resource damage settlements.
	State and federal natural resource trustees agree to accept these credits in settlement

at some time, and that the value of the credits will increase above the costs incurred to develop them. Under that scenario, restoration up front acts as a true market. The 4th variation, restoration credits trading, is viewed as a subset of investment restoration, except that it may apply at a single location—perhaps a CERCLA site—where 1 or more entities undertakes restoration with the intent to sell or trade credit among those who also share liability at the same site or within the same geographical region. Successful application requires that the state and federal natural resource trustees agree in any settlement to accept the credits from restoration conducted prospectively and that have been held in a restoration credit bank in the meantime. Clearly, there are overlaps among these 4 variations, and as noted earlier, there are likely to be other variations that we have not yet envisioned.

Determining ecological credits

Regardless of which of the 4 variations of prospective environmental restoration/restoration up front is to be used, the 1st step will be to determine ecological credits. For that purpose, the underlying tangible asset that will provide human use or ecological services is likely to be real property. Under this concept, we propose that the 1st step in determining the ecological credits is for a governmental natural resource trustee, or suitably approved or authorized

agency, to assess the natural resource service condition of the property and to assign to it a number of credits. We also believe, to offset some of the demand on state and federal trustee agency personnel, that some nongovernmental groups may be capable of undertaking this initial estimation, so long as they have been approved or authorized by the appropriate state and federal natural resource trustees. The credits will be for those human uses or ecological service flows estimated by trained professionals from observed functional levels at the time of the assessment/transaction and as determined by the type, size, and condition of the property or habitat in question. Properties and habitats may provide high human use or ecological-service flows as a result of their size, uniqueness, or other parameters applicable under generally accepted ecological and economic principles (Arrow et al. 2000).

As noted previously, much of the underlying economic and ecological tenets for the concept stem from NRDA practice, and much of the discussion herein reflect that practice experience. Thus, for this concept, we propose that, initially, the credits take the form of service acre years (SAYs), a term of art used in the NRDA process (NOAA 1996). A SAY is defined as the amount of ecological service provided by 1 acre of habitat over 1 y. In NRDA, discounting at 3%/y is typically used to account for the time value of the services, yielding discounted service acre years (DSAYs). The DSAY serves as a

currency exchange rate to compare losses and gains in ecological services at a specific point in time and is convertible to acres required to complete regulatory transactions. We recognize that the SAY and DSAY may not be the best, or even the most appropriate, forms for the credits and that they typically apply only to ecological service flows, not human uses; however, the terminology is familiar to NRDA practitioners and has received some review and analysis by scientists in the public and private sectors for a number of years. For those reasons, we believe they are useful as starting points.

The DSAYs and the habitat or property should be viewed separately, although, at 1st glance, that may seem confusing. Under this scenario, the DSAYs (in the abstract) are the currency exchange rate that allows habitat service acres (credits) to be bought, sold, transferred, donated, etc., separate from the property. The individual or group holding title to the property or habitat may or may not be the same individual or group holding title to the credits that are assigned to the property or habitat. In that way, a land owner may be able to achieve a fair and high return on the land without having to sell the property to developers, thus keeping the land available for potential restoration. Later in this article, we also illustrate how the same situation could apply to companies that own large tracts of land where limited or no manufacturing or operations have taken place. In contrast to the DSAY, the real property is the physical manifestation of the services provided, the basis for the credits, and that which needs to be maintained or managed so that the service flows continue through time.

Initially, projected DSAYs are set when the property or habitat is 1st examined and would reflect its existing ecological condition at that point in time. For the DSAYs to be durable, the property or habitat from which they stem must remain in the same or very similar (or improving) condition as when the original assessment was made, e.g., being maintained by the title holder as planned. When the DSAYs are needed to offset a liability, the property or habitat that generated them will once again be evaluated by the natural resource trustees, or its approved designee, who assigned the credits originally. Where the property or habitat has declined in quality, then so, too, shall the number of credits decrease. Where the property or habitat has improved in quality, or where the habitat has become much more valuable ecologically for whatever reason, then so, too, may the number of credits increase. However, the final assessment of applicable credits will be undertaken by the natural resource trustees, and the credits may either increase or decrease from the original assessment depending on the results of the validation of the service flows at the time when the credits are applied to offset a liability. The change in credits over time, either increasing or decreasing, will be subject to negotiation among the interested parties.

Operating an ecological service credit bank

Although some may argue that there is no need for an entity to operate an ecological credit bank, we think it will be necessary. The benefit of a bank is that it provides a central point of contact for the purchase, selling, trading, and holding of credits. We propose that a prospective restoration ecological credit bank could exist in a number of ways. One way is for a governmental agency, at the state or federal level, or perhaps 1 or more agencies that are well versed in the protection and enhancement of natural resources, could act as the bank.

Another possibility is that a nongovernmental group could choose to be the bank or to hold the properties and habitats involved or to take title to them. It is likely that nongovernmental groups would have to be licensed to operate the bank through the state or federal natural resource trustees or other governmental agency as is the case currently for wetland mitigation banks. As in any other form of bank, the operator may choose to assess fees for its services, and it would be required to operate under state and federal regulations that might be applicable to such an activity. Given the maturity of some of the wetland mitigation banks in several states, it is likely that the legal constructs for the management and operation of wetland mitigation banks could be readily applied to a similar bank for ecological service credits.

Maintaining ecological service credits—It should be recognized that the bank operator, regardless of whether or not it is a governmental agency, cannot guarantee that the projected DSAYs initially assigned to the property or habitat would remain at the same level over time. That places substantial accountability on the property or habitat owner to maintain the habitat in a way that preserves the ecological or human use service flows as much as is feasible. The property owner may need to restrict development, restrict or enhance public access, take action to restrict or eliminate invasive species, and other such actions that would ensure service flows are not impacted. During the time that the property is held in the bank and provided the habitats and services flowing from them have not declined significantly, the number of initial DSAYs afforded by the property should remain fairly constant. Unless there are ancillary agreements in place between the property owner, credit holder, and the appropriate government entity, there should be no interest or DSAYs gained or lost during the time the property is in the bank, i.e., the amount of DSAYs available to credit. Although that may appear to be a disincentive (DSAYs do not increase with time, unlike placing money in a bank and gaining interest on it), we believe that issue is best resolved through negotiation among the interested parties. There may be suitable arguments made on the merits of increasing or decreasing the DSAYs over time, but those discussions are beyond the scope of this article.

Where the owner chooses not to maintain the property or habitat in such a way as to ensure continued ecological service flows or chooses to use it for some purpose other than maintaining the DSAYs, then the individual or group holding the credits should expect the number of DSAYs initially assigned to be significantly lower than the actual projected DSAYs available for use, e.g., because of delayed initiation of habitat maturation before the transaction date. For this latter point not to become a source of litigation, it will be necessary for the land owner to confer and notify those holding the credits and the natural resource trustees of its plans before its implementation. Without a doubt, it will be important for the purchaser of the credits to ensure legal protections are in place to preclude the loss or significant decrease of the credits.

When the property or habitat is withdrawn from the bank, the initially assigned DSAYs are all no longer valid. However, that action does not mean the property or habitat no longer holds important ecological value. Even when a property or habitat is withdrawn, it could be placed back into the bank at a later date or used separately to offset a liability, but the number of DSAYs assigned to the original parcel of property may increase or decrease depending on a site-specific

evaluation by the governmental trustees or by those designated to do so on their behalf. The DSAYs associated with a parcel can be used only once as a restoration credit to ensure that there are no duplicative credits for the same parcel of property. In that situation, the process of estimating credits, etc., may have to begin anew with the same challenges and caveats discussed earlier.

Using ecological service credits—At the time the DSAYs or credits are placed into the bank, we propose that the natural resource trustee or its designee be required to notify the individual or group holding title to the property or habitat with formal, written documentation to that effect. The individual or group holding title to the property or habitat may withdraw it from the bank, with no penalty, at any time. Obviously, if the credits that stem from that property or habitat have been sold or traded to another entity, the land owner is obligated to inform and confer with that entity and the natural resource trustee before withdrawal takes place.

The documentation that sets up the DSAYs will be binding on the natural resource trustees in that the DSAYs can be applied, as noted above, to offset a variety of liabilities. When the credits are being applied to offset a particular NRD liability, only the natural resource trustees, in consultation with the property or habitat owner, can validate the amount of DSAYs for the property or the habitats in question.

DSAYs would be set in accordance with the types of habitats, human uses, and resources (service flows) found on that particular property at the time of the initial evaluation. DSAYs do not have a universal value but are dependent on the circumstances of the case in which they are being considered and, as we noted previously, are not typically used in estimating human uses. For example, if the property is primarily wetlands, the DSAYs stemming from the services thereof would be estimated on that basis. When the DSAYs are sold or transferred to another entity, and that entity wishes to offset a liability to a habitat other than wetlands, the trustee, at its discretion, may permit the use of DSAYs, subject to a conversion factor. In other words, DSAYs from an acre of wetland may be worth more or less from a natural resource service flow standpoint than DSAYs from a comparable acre of an upland habitat. Calculation of those conversion factors is beyond the scope of this article; however, trustees, in consultation with the individual or group holding title to the DSAYs, have negotiated case-specific conversion factors for similar situations at CERCLA and other sites over the past several years. Thus, there is precedent and basis for the use of conversion factors. Those conversion factors could be based on the prevalence or scarcity of the particular habitats in question and could also depend on the geographical area where the property or habitat is located. Conversion factors are not likely to be needed where similar banked and injured habitats are found; however, as noted below, that depends on how the property or habitat has been maintained from the time the DSAYs were assigned until its final disposition.

Once 100% of the DSAYs from a particular parcel of property have been used to offset a natural resource liability, that specific parcel cannot be used for that purpose again. Hence, the ability to offset a natural resource damage liability with DSAYs from any given parcel of property would be a singular event. However, where the number of DSAYs provided by a parcel of property is greater than those required to offset a natural resource damage liability, acres in excess of

those required to satisfy the DSAY debt at the transaction would continue to be available for that purpose at a later date, given the caveats noted earlier.

There could be situations, however, where the trustees, at their discretion, agreed that the number of DSAYs afforded by a property be increased even after all of the initially estimated credits have been used to offset a natural resource liability. For example, the property owner (or conservation group) may choose to undertake additional enhancements or restoration on the property, in consultation with the natural resource trustees, and thereby increase the level of human use or natural resource services above the level provided by previous improvements (e.g., preservation credits could be used in 1 transaction and, at a subsequent time, marsh or wetlands could be created in ponded, open-water area on the parcel to satisfy a second transaction). Those additional service flows and DSAYs could be transferred, donated, or sold and used by other entities needing to offset their own liabilities. The number of DSAYs and the ability to apply them for offsetting a natural resource damage claim, is something that will have to be negotiated between the relevant natural resource trustees and the entity needing to offset its claim. As noted earlier in this article, it will be important for this discussion to occur early so that the habitat involved and the potential credits that might apply from it are recognized by all parties. In situations outside of the natural resource damage arena, negotiations among the relevant parties will also be necessary to ensure successful implementation of the concept. We have not attempted to describe or discuss those potential situations.

The geographical boundary for the use of the initially assigned DSAYs is a matter to be negotiated between the owner of the DSAYs, the property owner, and the natural resource trustees. In general, the DSAYs should be readily applicable within the same state, watershed, flyway, or ecological region, provided the geographical boundaries are agreed to by all parties involved. Based on a review of NRDA settlements to date, there may be situations where the DSAYs could be assigned to a property in 1 state, watershed, or flyway, yet be used to offset injuries and damages in an adjacent state, watershed, flyway, or ecological region. A decision on the constraints of those geographical boundaries should be made case by case and involve the natural resource trustees, the DSAY owner, and the property owner. Any application of DSAYs to offset a liability, whether for dissimilar habitats or outside the immediate area where they are generated, will ultimately be subject to the legal requirement that the trustees show a reasonable nexus between the injuries giving rise to a natural resource damage claim and the restoration offered in compensation. In addition, all natural resource damage settlements are subject to public review and comment and court approval.

EXAMPLES OF INCENTIVE-BASED RESTORATION AND CONSERVATION OR ENVIRONMENTAL PROTECTION APPROACHES

The concept proposed in this article is not entirely novel but, rather, has a number of precedents set during the past 5 to 10 y. Those precedents include habitat conservation banks (as developed and used by US Fish and Wildlife Service [USFWS] for endangered species), wetland mitigation banks, and emissions trading. We do not attempt to imply equivalency among those examples and prospective environ-

mental restoration but provide this discussion only for illustrative purposes. The existing approaches described below have demonstrated that incentive-based approaches have been successful in increasing restoration and conservation or environmental protection in the United States, and they provide experience that may aid in the implementation of prospective environmental restoration/restoration up front.

One major difference with prospective environmental restoration/restoration up front is that it brings to the discussion the natural resource trustees and its agencies, most of which have not been heavily involved with wetland mitigation banks or emissions trading. It also has the potential to stimulate policy development at the state and federal levels that would then facilitate the ability of public and private entities to undertake restoration projects proactively, and thus while improving the environment, also possibly provide a potential financial (incentive) benefit. One could argue that today public and private entities are under no restraint to purchase property/habitats and undertake enhancements; however, as we noted earlier, there is no established mechanism where the entity could readily estimate or apply ecological credits to offset an NRD liability.

Conservation banks

As noted above, under the purview of the USFWS, conservation banks are important tools for ensuring the protection and maintenance of habitats that currently support, or could support, endangered species or other valuable plants or animals (USFWS 2003). That approach has been augmented by recent executive branch orders that advocate cooperative conservation as an approach to increase conservation of valuable habitats nationally (Bush 2004). A number of requirements for establishing and using habitat conservation banks are very similar to the elements proposed in this article. The prime example is that conservation banks seek to preserve properties and habitats in a way that maintains ecological service flows and conditions. Secondly, conservation banks target private land owners that have property and habitats that may be at risk for development. There have been some cases where actual credits have been estimated and used for specific habitats (J. Fox, Electric Power Research Institute, Palo Alto, CA, USA, personal communication).

Wetland mitigation banking

Wetland banks have increased in popularity during the past decade as a solution to achieve an economically effective and resource-efficient watershed approach for compensating for permitted impacts to wetlands under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, or a similar state or local wetland regulation. This is primarily due to the release of several federal interagency guidance documents, White House administration's affirmed commitments to achieve the goals of a no net-loss wetlands policy established in 1988, and many entrepreneurial mechanisms (USEPA and Department of the Army 1990; USEPA et al., 1995, 2002). In 2005, there were approximately 450 approved wetland banks and an additional 198 proposed banks throughout the United States (USEPA 2005). One of the most visible banking project is the USFWS Big Cypress Preserve in Florida, USA.

Wetland banks are privately held, state and federally licensed, and restore, create, enhance, or preserve (in excep-

tional cases) wetlands to serve as credits that may be sold to offset permitted wetland impacts from development activities within the bank's service area. The service area is determined in the permitting stage and is, generally, in the same drainage or watershed area of the bank.

Once the service area and impacts are determined, it is then decided whether a bank is appropriate. There are several factors to consider including the potential impacts that require mitigation, the timeframe of the impacts, the cost, and the number of future projects. Once a bank is deemed appropriate, the next step is to determine the type of banking instrument or contract that best meets the needs of the bank sponsor, the physical and legal characteristics of the bank, and how the bank will be established and operated.

A wetland mitigation bank is formed by following established federal and, if available, regional guidance. The number of credits and the ratio of credits to acres are negotiated with and approved by the mitigation bank-review team, in which several regulatory agencies are typically represented. Within a predetermined service area, the credits represent the ecological functions and can be used to compensate for an impact, whereas the debits represent the loss of the ecological functions. Credits can include upland buffer areas that benefit the site and overall watershed. This process can occur until all the available credits are depleted.

There are numerous parallels between wetland mitigation banks and the concept of prospective environmental restoration/restoration up front. Importantly, wetlands mitigation banking is well established and offers tools that can aid in the implementation of prospective environmental restoration/restoration up front. For instance, there are clear requirements and mechanisms for the public notice process as well as for long-term monitoring and 3rd-party verification of restoration success.

Emissions trading

Emissions trading provides an incentive to companies to reduce emissions by enabling them to earn emissions-reduction credits if they choose to reduce emissions more than the amount required and reducing the need for enforcement and legal action on the part of regulatory agencies. This market-based approach to emissions reduction is more decentralized and cost-efficient than the traditional command-and-control approach (Stavins 2000). The emissions-trading concept has been applied to the reduction or control of lead content in gasoline, ozone depletion, nonpoint sources of water pollution, acid rain, smog, and greenhouse gases.

Emissions-reduction credits are transferable and can be used to satisfy emissions standards at other discharge points where it may be more expensive to control emissions. Emissions banking allows companies to store credits for future use or to sell them to others. The ability to hold, transfer, and sell the credit is similar to the concepts proposed for prospective environmental restoration/restoration up front.

The trading of greenhouse-gas emissions has led to the recent establishment of markets and trading schemes, which are voluntary or, generally, cap-and-trade systems if established by governmental agencies. The "cap" refers to the total amount of emissions allowed in an area (e.g., a state, region, or country) to meet an environmental target set by the government. Each facility is allocated a number of allowances to

emit a certain amount of greenhouse gases. Flexibility is given in the manner in which a company meets its allowance. Companies can choose to invest in new technology, purchase allowances on the market, or the most time- and cost-effective combination of the two. Companies that keep emissions below their allowance are able to sell their excess allowances at the market price. The Chicago Climate Exchange® is the only voluntary, legally binding, greenhouse-gas emissions trading system in North America and consists of companies, municipalities, and others who sell and purchase credits on a real-time, electronic trading platform accessible on the internet (CCX 2006). The European Union Emissions Trading Scheme, which began operating in January 2005, is the largest multicountry, cap-and-trade, greenhouse-gas emissions trading scheme (EC 2005), and the Regional Greenhouse Gas Initiative (RGGI) is a multistate, cap-and-trade program consisting of northeastern and mid-Atlantic states in the United States (RGGI 2006). The State of California is in the process of developing a market-based compliance program (State of California 2006).

The result of the market-based emissions-trading approach is that environmental goals are achieved without undue limitations on economic growth and with efficient use of government resources. Firms have more flexibility to choose the most cost-efficient mix of controls, including the use of credits, to meet its emissions-reduction requirements and are encouraged to develop innovative technologies, because there is a demand for excess credits. Lessons from emissions trading that are applicable to prospective environmental restoration/restoration up front include the need for a common currency, a transparent accounting system to track credits and transactions, verification and monitoring, streamlined application requirements, a sufficient number of banks, and legally binding mechanisms to ensure future use of credits.

A BUSINESS PERSPECTIVE ON PROSPECTIVE ENVIRONMENTAL RESTORATION/RESTORATION UP FRONT

Without question, the importance of prospective environmental restoration/restoration up front is that it could provide the private sector and others with a mechanism to readily use their own habitats and resources at former or current manufacturing facilities or other properties not affected by contamination and to gain durable credits that can be held, traded, or sold. Although not the basis for this article, carried further, the concept may lead to the development of a new market system that could spawn businesses that will undertake investment restoration and conservation actions for the purpose of buying, selling, or trading credits. That, in turn, could also create incentives for public and private landholders to maintain or enhance their habitat tracts in ways that could increase, or at least maintain, existing ecological and human use service flows.

Similarly, there could be a concomitant increase in voluntary restoration and conservation projects across the United States, led by companies and other entities that own or manage real properties. In this latter case, the property or site may have ecological characteristics and attributes that provide far more value to the owner than traditional real estate transactions. Properties that might be amenable to this include wetlands, streams, or other habitats that are known to support protected species or habitat that is adjacent to wildlife refuges or other sensitive habitats. Rather than selling

property or a site with ecological value, it may be much more beneficial to place the property or site into a prospective restoration/restoration up front framework, and thereby capture the value of the ecological services in the form of credits. Hence the property or site may provide the owner with an efficient and less-costly means of resolving existing or future environmental liability (e.g., CWA Section 404 mitigation; RCRA mitigation for corrective actions; natural resource damages). Having a mechanism to place property or sites into such a program may also generate revenue for an owner who does not have an existing or potential liability. The revenue would result from selling or trading excess or unused credits to others that might have an existing or pending environmental liability. The public sector would also benefit from such a mechanism, particularly where credits could be traded, donated, or sold. Resolving liabilities may be facilitated by having a suite of options to choose from, thereby alleviating the often arduous process that agencies undertake to find restoration opportunities suitable for implementation. That, in turn, could increase the speed at which restoration is put in place, reduce transactional costs of achieving suitable timely settlements, avoid litigation, and enhance public interest in conservation.

CHALLENGES

At this writing, there are 2 locations in the United States where the concept of prospective restoration/restoration up front is being tested. One, which has not progressed as far as some had hoped, is located near Seattle, Washington, USA, and involves a host of responsible parties. Because the matter is still under active negotiation, greater detail is not available for publication. The 2nd site is located near Port Arthur, Texas, USA, and has progressed to the point of estimating DSAYs that would arise from each of a number of restoration options. Currently 2 companies are working closely with the state and federal natural resource trustees in Texas to finalize the DSAYs (credits), determine which of the restoration options might be suitable for implementation, and what legal frameworks are needed to ensure final settlement of potential liabilities. Similar to the situation near Seattle, Washington, the project in Texas is still being actively negotiated, and more details are not available for publication at this time.

Already the discussions of the concept, and the attempt to test it at 2 locations, have led to some challenges that will have to be addressed before the concept can become more widely accepted. These challenges can be categorized as 1) policy, or 2) technical.

Policy

A major challenge is that there are no policies in place, either federal or state, that detail or support the concept of prospective restoration planning/restoration up front. However, the development of regional restoration plans (e.g., State of Louisiana 2003; K. Debusschere, Louisiana Oil Spill Office, Baton Rouge, LA, USA, personal communication) may be one way to negate the need for the development of federal or state policy. When regional restoration plans are developed, they undergo substantive review, consultation, and interaction among the federal and state natural resource trustees, wildlife agencies, conservation groups, the public, etc. These plans detail the restoration options in a particular region, and because of the public vetting of the plan and the options contained therein, they may also comply with the

National Environmental Policy Act (NEPA). This latter point is key to obtaining federal and state regulatory and natural resource staff support for the selection and implementation of any potential restoration option. However, developing regional restoration plans takes time, resources, and a dedicated group willing to undertake the work involved.

A related challenge is in applying the concept to future natural resource damage claims. Often the specifics of a particular spill or release of hazardous substances or oil in the future is not known. Because of that, there is substantial spatial and temporal uncertainty regarding when, where, or whether credits may apply. Although these challenges are not insurmountable, they are nonetheless significant and will be faced as the concept is applied in specific instances.

Technical

There are a number of technical issues that will require substantive work. First, we proposed that the DSAY serve as the common currency for the credits, yet we also recognized that this may not be the best or most appropriate form. There may be other approaches that would be better than the DSAY approach, but that is something to be evaluated in the future, and which would, perhaps, be the subject of an additional manuscript. Second, there will need to be a sufficient cadre of trained individuals in federal and state natural resource agencies, or their designees, who can ascertain the human use and ecological service flows that stem from a habitat under consideration. Currently, staff at the state and federal natural resource agencies is focused on issues of prime importance to the mission of those respective agencies, and being available routinely for estimating human use and ecological service flows may prove highly problematic. The lack of such individuals, or the lack of time they can devote to the estimation of credits may seriously inhibit the process. For that reason, it will also be important to reach consensus on whether there can be an approval process for nongovernmental entities to take on the task of evaluating habitats and estimating ecological service credits. That, too, will take time and will certainly require that public and private entities engage in substantive dialog over the next few years.

CONCLUSION AND RECOMMENDATIONS

In this article, we have endeavored to illustrate a new concept that is designed to increase restoration and conservation nationally. At its core, the concept is based on the ability of an entity to undertake restoration proactively and thereby gain credits that are durable and can be held, traded, or sold to others that might need them. The precedent and business models exist today that provide support for this proposed concept.

We propose that much of the concept for prospective environmental restoration/restoration up front be built upon the existing knowledge and practice exchange that has occurred over the past 5 to 10 y under the natural resource damage-assessment paradigm. That paradigm can provide a good, recognizable framework to begin the implementation of the proposed concept at sites in various parts of the country, and thereby, to test its ability to achieve the benefits we have described. We are hopeful that this concept and its description herein will stimulate open, candid dialog among the public and private sectors and, eventually, result in federal and state policies that codify this approach as a useful

mechanism for increasing restoration and conservation across the nation.

Acknowledgment—The authors are indebted to a number of scientists, lawyers, and decision makers in the governmental, academic, and conservation communities who have engaged in substantive dialog over the past several years. Their insights, suggestions, and other advice have been instrumental in the development of this concept paper. We are also indebted to those individuals who provided peer review of the manuscript and valuable suggestions on how to improve it.

Disclaimer—The views expressed in this article are those of the authors and do not represent the official policy, guidance, or positions of any of the organizations named herein.

REFERENCES

- [API/NOAA] American Petroleum Institute/National Oceanic and Atmospheric Administration. 2004. Regional natural resource damages and cooperative assessment workshop. www.noaa.gov. Accessed 29 March 2007.
- [API/NOAA] American Petroleum Institute/National Oceanic and Atmospheric Administration. 2006. Regional natural resource damages and cooperative assessment workshop. www.noaa.gov. Accessed 29 March 2007.
- Arrow K, Daily G, Dasgupta P, Levin S, Goran Maler K, Maskin E, Starrett D, Sterner T, Tietenberg T. 2000. Managing ecosystem resources. *Environ Sci Technol* 34:1401–1406.
- Bingham G, Bishop R, Brody MS, Bromley D, Clark E, Cooper W, Costanza R, Hale T, Hayden G, Kellert S, Norgaard R, Norton B, Payne J, Russell C, Suter GW. 1995. Issues in ecosystem valuation: Improving information for decision making. *Analysis. Ecological Economics* 14:73–90.
- Brody MS, Kealy MJ. 1995. Issues in ecosystem valuation: improving information for decision making. *Forward. Ecological Economics* 14:67–70.
- Bush GW. 2004. Executive order 13352, Nr. 167. 26 August 2004. *Federal Register* 69:52989–52990.
- [CCX] Chicago Climate Exchange®. 2006. Chicago Climate Exchange. www.chicagoclimatex.com. Accessed 25 October 2007.
- [DEFRA] United Kingdom Department for Environment, Food, and Rural Affairs. 2006. An operator's guide to the EU emissions trading scheme. Ver. 1. London (UK). www.defra.gov.uk/environment/climatechange/trading/eu/pdf/operatorsguide.pdf. Accessed 25 October 2007.
- [EC] European Commission. 2005. EU emissions trading: An open scheme promoting global innovation to combat climate change. Brussels (BE): Directorate-General for the Environment.
- [NOAA] National Oceanic and Atmospheric Administration. 1996. Guidance document for natural resource damage assessment under the Oil Pollution Act of 1990: Injury assessment. Silver Spring (MD): NOAA Damage Assessment and Restoration Program. PB96-199427.
- Partnership for the Delaware Estuary. 2007. Second Delaware Estuary science conference. Linking science, management and policy to set achievable environmental goals in the Delaware Estuary. www.delawareestuary.org. Accessed 22 January 2007.
- [RGGI] Regional Greenhouse Gas Initiative. 2006. Regional Greenhouse Gas Initiative: An initiative of the northeast and mid-Atlantic United States. www.rggi.org. Accessed 25 October 2007.
- State of California. 2006. Global Warming Solutions Act of 2006. Sacramento (CA): State of California. AB 32.
- State of Louisiana. 2003. The Louisiana Regional Restoration Planning Program, Regional restoration plan, region 2, September 2003. Baton Rouge (LA): State of Louisiana Oil Spill Office.
- Stavins RN. 2000. *Economics of the environment*. 4th ed. New York (NY): WW Norton.
- [USDOI] US Department of the Interior. 1987a. Injury to fish and wildlife species. Washington DC: USDOI. PB88-100169.
- [USDOI] US Department of the Interior. 1987b. Type B technical information document; techniques to measure damages to natural resources. Washington DC: USDOI. PB88-100136.
- [USEPA] US Environmental Protection Agency. 2005. Mitigation banking fact sheet. www.epa.gov/owow/wetlands/facts/fact16.html. Accessed 29 March 2007.
- [USEPA] US Environmental Protection Agency, Department of the Army. 1990. Memorandum of agreement and the determination of mitigation under the

- Clean Water Act section 404(b)(1) guidelines. Washington, DC: USEPA, Department of the Army.
- [USEPA] US Environmental Protection Agency, Department of the Army, US Department of Agriculture, Department of the Interior, Department of Defense. 1995. Federal guidance for the establishment, use, and operation of mitigation banks. Nr. 228. *Federal Register* 60:58605-58614.
- [USEPA] US Environmental Protection Agency, Department of the Army, US Department of Agriculture, Department of the Interior, National Oceanic and Atmospheric Administration, US Department of Transportation. 2002. National wetlands mitigation action plan. Washington, DC: National Wetlands Mitigation Action Plan.
- [USFWS] US Fish and Wildlife Service. 2003. Guidance for the establishment, use, and operation of conservation banks. Memorandum. Washington DC: USFWS.
- White House. 2005. White House conference on cooperative conservation. St. Louis (MO): US Department of the Interior.