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Landowner Compensation for Dispersed Temporary Water Storage to Mitigate Low Frequency Flooding

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Executive Summary:

Land rental costs associated with a proposed large-scale and dispersed floodwater storage project (called the Waffle®) in the Red River Basin (RRB) of North Dakota and Minnesota, are estimated through: GIS-based spatial overlays of township cropland rental values with optimal floodwater storage locations, surveys of RRB landowners used to elicit their assessments of storage impacts and their required compensation levels, and, observed compensation rates paid to landowners in a separate but nearby floodwater storage project in Devils Lake, North Dakota. The land rental costs associated with Waffle storage are estimated at $43.7 million per year of storage (2006 dollars). These estimates do not include any program administration fees or implementation costs. The land rental costs are particularly large since the most optimal storage locations (from a hydrological standpoint) are where land values in the RRB are highest. On average, storage on optimal storage sites costs 28% more than if on average (RRB-wide) land. These resulting high land rental costs are shown to limit the economic feasibility of Waffle storage, particularly since more than $600 million has been spent on flood mitigation projects in the RRB since the large-scale flood event of 1997.

Introduction

Non-structural flood damage mitigation programs are frequently proposed and implemented in the Minnesota and North Dakota portions of RRB, which is subject to regular and severe springtime flooding, most recently in the record flood event of 1997 (Todhunter, 1997 and IJC, 2000). Such flood mitigation efforts, which include wetland restoration, construction of dry-dams, and controlled flooding of farmland, on either a permanent or temporary basis, usually require renting or purchasing agricultural land from private landowners. It is almost always assumed by the proponents of these projects that landowners will accept compensation in accordance with local market real estate values (i.e., the amount which they could sell or rent the land to other agricultural producers). However, if landowners demand payments substantially above local market real estate values (i.e., 'premiums'), then project costs will be underestimated leading to misleading economic feasibility analyses biased in favor of flood mitigation projects.

This study estimates the likely land procurement costs associated with implementing Waffle storage across the North Dakota and Minnesota portions of the RRB based on: 1) GIS-based spatial overlays of township specific land rental values and physically optimal storage areas; 2) A survey of RRB landowners; and 3) Observations on required landowner compensation levels associated with the nearby Devils Lake flood storage program (1996 to 1999). In the final section of paper, Waffle storage land procurement costs are evaluated in relation to potential benefits of flood control (i.e. reduced future flood damage) in light of recent (post 1997-flood) flood mitigation efforts in the RRB.

Background and Previous Literature

Dispersed floodwater storage projects require an understanding of several key issues. First, what is the hydrological relationship between the dispersed stored water and peak flow at various locations in the main stem? Second, what are the technical/physical issues of managing releases on each of thousands of dispersed storage cells? Third, what is the feasibility of using roads as dams and dikes? Fourth, has the effect of recent and planned flood damage mitigation projects been netted out of the benefits of dispersed storage? And, finally, what are the socioeconomic issues with landowner participation in dispersed storage projects? This study concentrates on the last issue, that of landowner participation, while the other issues are no less important.

The need to account for stakeholder participation in watershed-based project planning has been well established (Habron, 2004 and Wagner, 2005). However, no known studies have actually attempted to quantify, ex-ante, the payment required by landowners to participate in watershed-level flood mitigation programs. In contrast, most simply assume that landowners will accept average local rental values as reported by either the National Agricultural Statistics Service (Shultz and Leitch, 2003) or established local conservation reserve program (CRP) rental rates (Manale, 2001).

The RRB comprises 17,000 square miles of primarily agricultural land in eastern North Dakota, northwestern Minnesota, a small corner of northeast South Dakota, and southern Manitoba. Because it is almost as wide as it is long, extremely flat, and drains via the Red River from south to north, the RRB is subject to recurrent springtime flooding in April and May, especially when preceded by abnormally high fall and winter precipitation combined with rapid snowmelt and/or spring rains (Todhunter 2001). The most recent large-scale flood event (classified as either a 100-year plus and/or a 500-year event) occurred in 1997, and resulted in damages estimated to range from $1.5 to $2.0 billion (Shultz and Kjelland, 2002)

The only large-scale dispersed floodwater storage project to have occurred in the RRB is the Available Storage Acreage Program (ASAP) in the Devils Lake Watershed (in northeastern North Dakota, approximately 90 miles west of Grand Forks, North Dakota). To relieve downstream flooding in the City of Devils lake, the ASAP program intended to semi-permanently store 35,000 acre feet of water on 75,000 acres of privately owned land based on 1 or 2-year short-term contracts. Payment values were based on competitive bids submitted by landowners to the State (North Dakota State Water Commission, 1997 and 1999).

Voluntary participation in the ASAP program was much lower than expected and by the end of 1999, only 13,200 acres were enrolled in the program resulting in 159 storage contracts for 20,500 acre-feet of storage. Total payment costs from 1996 to the end of 1999 were $2.6 million. A review of official State Water Commission records (total of 158 ASAP contracts totaling 12,950 acres over the 1996 to 1999 time period) indicates that: storage acreage ranged from 2 to 860 acres with an average size of 83 acres. Payments to landowners averaged $81/acre with a standard deviation of $28/acre (which were on average 153% higher than local rental values in the area. The program was discontinued in 2000 due to limited landowner participation, excessive costs, and limited hydrologic impacts of storage on flood damage.

The Waffle flood control concept is currently being promoted and evaluated by the Energy and Environmental Research Center (EERC) with funding from a congressional appropriation of $4.5 million (EERC, 2003). It would involve having landowners throughout the RRB (17,000 square miles) temporarily store water on their land in the early spring to reduce the magnitude of large downstream flood events. As currently proposed, the Waffle project would reduce the peak floods of major (low frequency) flood events similar to the catastrophic 1997 flood event, and thus mitigate flood damage primarily in urban areas along the main-stem of the Red River in Minnesota and North Dakota (Wahpeton/Breckinridge, Fargo/Moorhead, Grand Forks/East Grand Forks), as well as Winnipeg, Canada.

Based on field data collection, GIS analyses, and hydrologic modeling, the EERC has recently identified the optimal ('good' to 'excellent') locations for temporary Waffle storage based on storage capacity and hydrologic data (EERC, 2005). This optimal land is mostly concentrated along the main-stem of the Red River (which is widely known to be comprised of the flattest and most productive land in the RRB), and in a few pockets in the northeastern corner of the RRB (in Minnesota).

The EERC also conducted a landowner survey in the Wild Rice (Minnesota) sub-watershed in the spring of 2004 (EERC: Waffle Newsletter, Fall, 2004). The response rate to the survey was 11.8%. Only 16% of respondents stated they would 'definitely' consider participating in Waffle storage, while 36% said they 'definitely would not' participate. The remaining 48% are indecisive. However in a more recent news release the EERC says that based on this same survey that 46% of landowners in the RRB are interested in participating in the storage program (EERC, 2007). The surveys did not specify to landowners whether their participation would be compensated or voluntary.

The EERC plans to releases their complete study report in July, 2007 but they have already indicated in a related press release that Waffle storage would generate substantial reduction in peak flows and if in place at the time, would have averted much of the $2 billion in damages associated with the historic 2007 Red River flood (EERC, 2007). It is not yet clear whether these analyses will fully account the land rental costs associated with storage and an array of other administration, implementation, and logistical costs.

Methods and Results

1) Identifying RRB-Wide and Waffle-Optima Land Rental Values

A township-level land value database was created by using different approaches for North Dakota and Minnesota since land value data availability differs in each state. In North Dakota the most reliable and accurate land rental valued data is available from county level surveys conducted by the National Agricultural Statistics Service (with funding from the State Lands Department). However, this present study required more site-specific (sub-county) rental value data so reported county cropland rental value data was interpolated to particular townships across individual counties based on GIS-based classifications of the relative productivity of each township (based on SSURGO soil productivity measures, cropping patterns, and continuous maps of land values based on actual sales). These particular land value interpolation

methodologies are described in greater detail in Shultz (2005a & 2006). In townships dominated by pastureland, NASS pasture values were utilized to more accurately reflect land values even though there is relatively little pasture land in the North Dakota portion of the RRB.

In Minnesota, rental values are not widely reported but land value estimates (based on actual market transactions and the estimates of local tax assessors are reported on a township level basis) by the Department of Revenue and reported by Minnesota Land Economics (2007). These values (the value of tillable acres on a per acre base) were converted to cropland (tillable) rental rates using capitalization rates of between 6.2% and 7.4%. Specific capitalization rates estimated were based on observed capitalization rates (value to rental ratios) in the adjacent and/or similar counties of North Dakota (directly adjacent to Minnesota Counties). Alternatively, a limited reporting of rental values by the University of Minnesota Extension Service (2006), reported rental rates for 7 of the 19 Minnesota counties in the RRB. From these (and reported Department of Revenue Land Values, capitalization rates in these 7 counties was on average 6.3% in 2005. These rates are considered close enough to justify our capitalization rates for the Minnesota portion of the RRB.

Average rental values in North Dakota (1,706 townships covering 1.2 million acres) are $45/acre versus $66/acre in Minnesota (453 townships and 900,000 acres). The RRB-wide average cropland rental value is $54/acre.

The resulting township level GIS coverage of year 2006 cropland rental values for the entire North Dakota and Minnesota portions of the RRB (Figure 1) was then spatially overlaid with cropland land areas deemed optimal (good to excellent)for Waffle storage by the EERC (Figure 2). The rental value of optimal storage land is $69/acre which is 28% more than all land in the RRB. Using 2004 land value data, optimal land costs only 20% more than all land which indicated that the relative value of optimal storage land is increasing at a greater rate than all land in the RRB

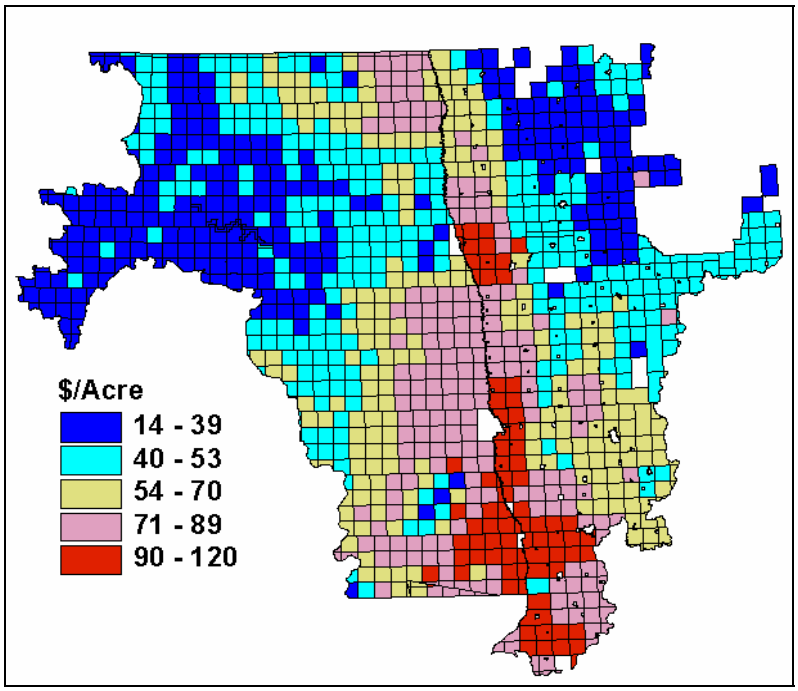

Figure 1. Year 2006 Township Specific Land Rental Values Across the Red River Basin (All Land $54/acre; Optimal Storage Land: $69/acre)

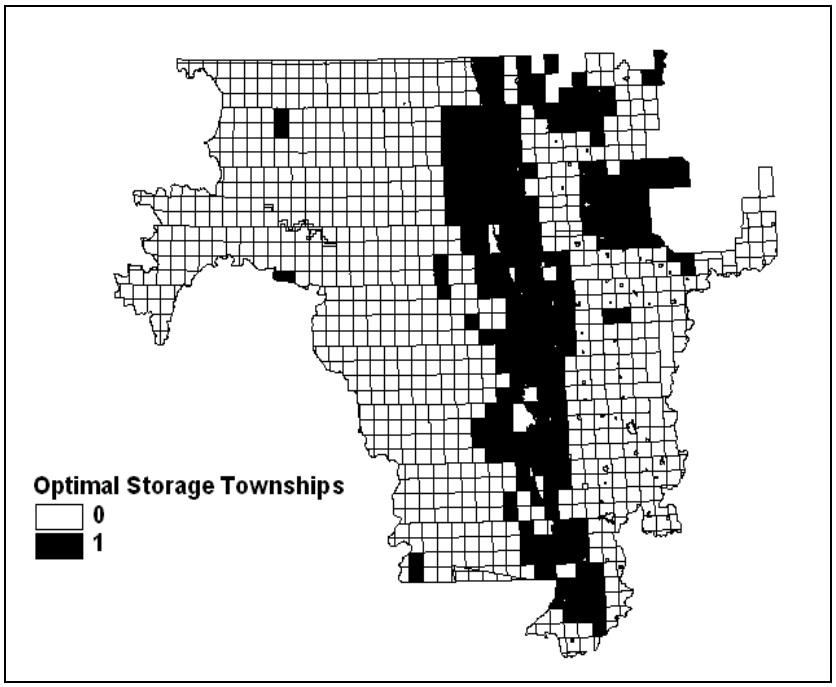

Figure 2. Townships with Optimal Conditions for Waffle Storage (based on EERC, 2005)

2) Surveys of RRB Landowners to Estimate Required Levels of Compensation

Personal surveys were administered in early 2005 to 107 agricultural landowners from throughout the North Dakota and Minnesota portions of the RRB to measure how they assess the potential impacts of Waffle storage on their agricultural operations and to quantify their willingness to accept payments for both participation (i.e. a retainer fee) and for actual storage (when needed). Participation retainers are intended to compensate landowners for committing themselves to future storage and for installing storage control systems on their lands, and to compensate them for various administrative paperwork and contract signings.

Premiums for actual storage are expected to result from landowners being uncertain regarding potential negative impacts that storage would have on future agricultural production. Landowners are also assumed to be concerned with whether they would remain eligible for crop insurance programs after voluntarily storing water on their land, and other potential opportunity costs associated removing land from production in the form of under-utilization of available machinery and labor).

The surveys were administered to agricultural landowners attending two different agricultural meetings (the Northwest Farm Managers Annual meeting in Fargo and the Northern Crops Exposition in Grand Forks) Landowners were first asked if they would be interested in participating in Waffle storage (70% were). Those 'interested' were then asked what retainer fees they would require to ensure their participation in the program (most, the group average) stated they would require single-year's rental payment for a retainer (assuming no storage was needed over a 10-year contract).

Finally landowners were asked about the amount of compensation they would require in order to store floodwater on their land in the early spring for several weeks under four scenarios and corresponding premium values (see Table 1). Premium values were presented as a percentage of current rental values. Under all scenarios, landowners were informed that a retainer fee of a year's storage would be paid to them over a 10-year period if Waffle storage was never actually required.

On average the RRB landowners require premiums of 150% of local rental values to participate in Waffle storage. It is very surprising that this premium is almost identical to the observed premiums required by landowners participating in the earlier Devils Lake floodwater storage program, particularly since the Devils Lake project required full season storage while proposed Waffle storage is only for several weeks. Clearly, RRB landowners who have first hand knowledge of the springtime conditions of their fields believe that Waffle storage will negatively impact their farming operations.

Table 1. Land Rental Premiums Required by a Sample of RRB Landowners to Participate in Springtime Waffle Flood Storage.

Required Premium (above rental rates) Required to Participate in Waffle Storage	Scenario/Rational	% of Surveyed Landowners Who Selected This Premium/Scenario
0%	No expected damage to harvest	5%
50%	Delayed Planting	13%
100%	Lost Harvest	33%
200%	Lost Harvest & Opportunity Costs	49%

Average premium required: 150% (on average $81/acre RRB-wide)

3) Summary: Storage Costs Over a 10-Year Period.

Assuming that Waffle storage would only occur on farmland with good to excellent potential for storage (approximately 600,000 acres), and that only 70% of landowners appear interested in participating in the program (if compensated), approximately 420,000 acres is considered available for storage. Assuming that storage would be needed at least once over a 10-year period (either because it is needed for a large scale flood event, or alternatively as a retainer payment to landowners for participating), total land procurement storage costs range from $22.7 million (under the unlikely scenario of being able to use all rather than just optimal storage land combined with the unrealistic assumption of no price premiums required by landowners), to $43.7 million (based on optimal storage land values and with a landowner premium requirement of 150%). If storage is needed more than once in a 10-year cycle, cost will increase accordingly ($43.7 million for each year of needed storage). It is important to note that these costs do not include any program administration fees and implementation fees which as noted by anecdotal and empirical evidence from other landowner conservation programs in the region can greatly increase total land procurement costs (USDOI, 1998 and Shultz, 2005b)

Table 2. Annual Land Renal Costs for 416,000 Acres of Waffle Storage Across the RRB (2006 Dollars)

Storage Scenario	**Land Costs with No Premiums**	**Land Costs with 150% Premium**
Mix of land throughout the RRB (average values)	$22.7 Million	$34 Million
Land with good to excellent storage potential	$28.9 Million	$43.7 Million*

** Most realistic scenario*

Summary and Conclusion

Land most suitable for Waffle storage is valued, on average, 28% more than RRB-wide land. This, combined with the fact that likely premiums required by landowners (based on observation in the Devils Lake project and surveys of RRB landowners) are around 150%, the land rental component of Waffle storage is quite expensive ($43.7 million per year or needed storage).

The high cost of renting land for the proposed Waffle floodwater storage project in the North Dakota and Minnesota portions of RRB combined with other procurement costs (ranging from engineering studies and field survey required to select, design, and monitor storage sites, the construction and maintenance of storage control structures, and various administrative tasks) indicate that such a storage project is very unlikely to be economically feasible.

In addition to the high land rental costs, infeasibility is likely to occur since Waffle storage has a questionable impact on reducing peak flood flows, and because future flood damage in the RRB is likely to be considerably less than historic (particularly 1997) flood damage. This is a direct result of the extensive flood mitigation efforts that have occurred in the RRB after the 1997 flood. These include: the buyout of floodplain homes, and dike and retention ponds in Fargo for $70 million, buyouts of floodplain homes in Grand Forks for $94 million, dike construction in Grand Forks ($409 million), the construction of the Maple River dry-dam in West Fargo (22.5 million) and a variety of similar projects in smaller towns throughout the RRB (Federal Gazette, 2006 and the Nowatski 2006). These mitigation projects easily exceed $600 million and they will very likely result in reduced risks from future flood damages. In other words, the likelihood of repeated flood damages as observed during the 1997 flood ($1.5 to $2 billion in damages) is greatly reduced and this needs to be accounted for in the analysis of future flood mitigation projects. In other words, the proponents of flood mitigation projects in the RRB should not continue to use the $1.5 to $2 billion in reported 1997 flood damages without adjusting for post-1997 mitigation efforts.

Similarly, if a Waffle storage program was put in place right after the 1997 flood event, it would have, in the last 10-years, cost at least $42 million in fixed land procurement costs (assuming landowners would require a retainer fee equal to 1 year of storage or conversely if storage was needed for one-year). But, during that time period there have not been any significant flood events in the RRB that would have been mitigated by Waffle storage.

It is hoped that those evaluating the feasibility of the Waffle and other types flood mitigation projects in the RRB and in other parts of the country, recognize the need to accurately quantify the costs required to compensate landowners for temporarily or permanently storing water on their land. The present study has shown that his requires site-specific land value data integrated with hydrological and landscape modeling along with an honest assessment of the extent of premiums demanded by landowner.

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