Concurrence Point No. 2

Alternatives Designation

Green Meadow Project Team/Wild Rice Watershed District

The attached "Alternatives Designation" Spreadsheet is intended to document:

- The range of alternatives considered by the Project Team and the Watershed District to address the project goals and objectives
- The final determination and rationale used to eliminate an alternative or carry it forward for further analysis.

Information is presented in columns:

Flood Damage Reduction Measure –Identifies the range of alternatives that were screened. The range alternatives to address the project purpose (goals and objectives) were identified by Watershed District and individual Project Team members following the development of the problem statement, goals and objectives, project purpose and need, and review and discussion of the flood damage reduction measures including, but not limited to those identified in the MN Flood Damage Reduction Work Group Technical Paper 11, Red River Basin Flood Damage Reduction Framework (http://www.rrwmb.org/files/FDRW/TP11.pdf).

Red River Timing Zone Appropriate – Appropriateness of the alternative based on its subwatershed location (timing) relative to its runoff contribution to the Red River of the North (http://www.rrwmb.org/files/FDRW/TP11.pdf).

Alternative Screening Rationale – Three columns providing the rationale applied to make a final determination of the alternative as Primary, Secondary, and Not Practicable:

- **Primary Rationale** – The primary rationale for alternative designation is based on the concurrence point #2 spreadsheet (attached). The table has been incorporated into recent Red River Basin watershed plans that were approved by the U.S. Corps of Engineers. Failure to meet a single criteria resulted in an alternative being designated as Not Practicable:

    1. Reasonable expectation of obtaining land:
        a. Absentee landowner.
        b. Non-active farm.
        c. Non-cultivated land lacking quality natural resources.
        d. Known landowner willing to execute legal documents for option to buy, provide easement, or participate.
        e. State or federally owned and support for project.
    2. Position in the watershed relative to the problem area:
        a. Alternatives with local benefit.

i. Must be located in sufficient proximity to influence the problem area (e.g. timing and location within the local watershed).
ii. The relative contribution of peak flow and runoff volume to the problem area from the contributing drainage should exceed some minimum threshold (e.g., 10% of the peak discharge for the design event).

b. Solutions with Red River of the North benefit:
i. RRWMB STAR Value acceptable for funding
ii. Subject to Mainstem Effectiveness Analysis per TSAC Technical Paper No. 11, Figure 26 (http://www.rrwmb.org/files/FDRW/TP11.pdf).

3. Technical feasibility. All of the following must apply to be considered technically feasible:
   a. Suitable soils and subsurface conditions.
   b. Physically possible (i.e., topography and hydraulic gradeline work).
   c. Operationally feasible (e.g., if dependent upon the operation of other facilities, obtain written agreement; operation is not so complex as to create doubt about realizing anticipated benefits).
4. Willingness to pay and cost:
   a. Local cost component can be no greater than the 75th percentile unit costs for similar projects (e.g., $ per acre-foot, $ per acre of wetland restored) evaluated separately for Flood Damage Reduction and Natural Resource Enhancement benefits.
   b. Willingness to pay for local benefits received exemplified by acceptance at Preliminary Hearing under 103D.
5. Existing Technology:
   a. Technique, method, or approach should not be untested or considered experimental. There should be some example(s) of application of the technique, method, or approach in a similar landscape setting showing some reasonable measures of feasibility and success.
6. Logistics:
   a. Reasonable expectation of obtaining the financial resources necessary for project component construction/implementation (i.e. structure construction/ag. BMP installation).
   b. Reasonable expectation of obtaining permits and necessary approvals (i.e., project is not contrary to agency statute or rule, requiring revision of statute or rule) nor requiring special legislative authorization to proceed.
   c. Some level of assurance that voluntary participation in applying identified needed BMP's will take place.
   d. Materials necessary for constructing the project are available.
7. Environmental:
   a. Related to Ability to Implement the Project.
      i. Jeopardy to continued existence of federally listed endangered and threatened species or their critical habitats.
      ii. Potential impact to lands with special protection or management status (e.g., state or national park).

iii. Special resource designation (e.g., wild and scenic river; state natural and scientific area).
iv. Resource with special protection status under state or federal laws (e.g., outstanding resource value water).
v. Potential impact to lands with special protection or management status (e.g., state or national park).

b. Likely Affecting Alternative Selection Process:
i. Documented high quality ecological resource (e.g., from Minnesota Biological Survey).
ii. Native American or other substantive cultural resources.
iii. Relative amount of aquatic resources impacted (e.g., wetland acreage).

- **Additional Rationale** – Additional discussion of the secondary factors used to arrive at the final screening designation.

- **Alternative Description** – A more detailed description of the alternative and the anticipated effect related to the project purpose (goals and objectives).

Final Designation - The final alternative designation (Primary, Secondary, and Not Practicable) made by the Project Team and Watershed District. Alternatives are also color-coded:

- Red – Alternatives that are NOT PRACTICABLE or were initially carried forward and subsequently eliminated from further analysis after further review from the Project Team and Watershed District

- Yellow –Alternatives that are SECONDARY. These alternatives would meet the project purpose and are supported by the Watershed District and the Project Team but not included in further detailed analysis by the Project Team or Watershed District because they will be promoted and implemented by other entities (e.g. Soil and Water Conservation Service) in the subwatershed.

- Green – PRIMARY alternatives that are carried forward for detailed analysis by the Project Team/Watershed District.

APPENDIX A: Green Meadow Project Team Member/Stakeholder

NAME	STAKEHOLDER
Brett Arne	Board of Water and Soil Resources
Shawnn Balstad	Natural Resources Conservation Service
Steve Bommersbach	Norman County Commissioner
Mark Chisholm	Landowner
Mike Christiansen	Wild Rice Watershed District Manager
Mark Christianson	Soil and Water Conservation District
Duane Erickson	Wild Rice Watershed District Manager
Diane Ista	Landowner
Curt Johannsen	Wild Rice Watershed District Manager
Tara Mercil	Minnesota Pollution Control Agency
Larry Puchalski	US Army Corps of Engineers
Emily Siira	Department of Natural Resources
Dave Vilmo	Landowner

Concurrence Point No. 2 -Array of Alternatives and Alternatives Carried Forward
Green Meadow Subwatershed - Wild Rice Watershed District (DRAFT 5-9-14)

	Red River Timing Zone				Alternative Screening Rationale		
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
1) Reduce Flood Volume							
a) Wetlands (providing infiltration and evapotranspiration)	+	++	++	Not Practicable as primary alternative for further analysis based on: 1, 2, 4 and 6. The primary reason for eliminating the alternative was Item 6 - Logistics. This alternative will require voluntary participation using existing programs (WRP, RIM, CRP…)and will be considered as a **SECONDARY** alternative to be implemented on a voluntary basis by others (SWCD, NRCS, etc.).	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future projects in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis (due to concerns about limiting bounce to minimize vegetative impacts), the cost per ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio.	Depressional areas within the landscape capture runoff and allow time for evaporation and infiltration to occur, which normally results in natural seasonal drawdown. This drawdown storage is replaced during subsequent runoff events which reduces the downstream flood volume. However, most depressional areas only have enough capacity to retain an initial portion of the runoff associated with major flood events. Therefore, from the standpoint of timing to reduce main stem flood peaks, these will be most beneficial when located within late contributing areas. However, depressional wetlands located in the southwest area of the Red River Basin will typically provide somewhat greater available retention capacity than those located in northeastern areas, because of the differing evaporation rates.	Secondary
b) Cropland BMPs (increase infiltration and evapotranspiration)	+	++	++	Not Practicable as a primary alternative for further analysis based on: 1, 2, 4 and 6. The primary reasoning for eliminating this alternative was item 6 - Logistics. This alternative will require voluntary participation using existing programs for implementation of cropland BMPs and will be considered **SECONDARY** alternative to be implemented on a voluntary basis (SWCD, NRCS, etc.).	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future Cropland BMPS in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis, the cost per ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio.	Cropland management practices have been developed to conserve soil and water resources. These are collectively referred to as best management practices (BMPs). The most commonly used agricultural BMPs are forms of conservation tillage that leave the soil better protected by crop residues than other tillage methods. This may also increase infiltration, thereby reducing runoff. The reduction in runoff varies with the topography, amount of rain, and type of soil. Based on Natural Resources Conservation Service (NRCS) runoff estimating procedures, a reduction in runoff of about 5% to 8% typically may be expected with conservation tillage practices. This method is appropriate to apply in all areas of the basin, but requires large areas of application to substantially reduce peak flows in rivers.	Secondary
c) Conversion to Grassland (e.g., CRP and RIM to increase infiltration and evapotranspiration)	+	++	++	Not Practicable as a primary alternative for further analysis based on: 1, 2. 4 and 6. The primary reasoning is Item 6 - Logistics. This alternative will require voluntary participation using existing programs (WRP, RIM, CRP…) and will be considered as **SECONDARY** alternative to be implemented on a voluntary basis by others (SWCD, NRCS, etc.).	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future Conversion to Grassland in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis, the cost per ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio.	Perennial grassland including CRP, hay meadow, and well-managed pasture produce much less rainstorm runoff than cultivated cropland. A typical reduction in storm runoff is estimated to be about 50% compared to row-cropped lands with conventional tillage methods. However, the effects on snow accumulation and spring snowmelt runoff have not been well documented. Using NRCS runoff estimating procedures, it can be shown that the greatest reduction in storm runoff through conversion of cropland to perennial grassland is achieved on lighter soils such as sandy or silty loams.	Secondary
d) Conversion to Forest (forested areas generally have the lowest runoff coefficients, due to high interception and evapotranspiration)	+	++	++	Not Practicable as a primary alternative for further analysis based on: 1, 2, 4 and 6. The primary reasoning is Item 6 - Logistics. This alternative will require voluntary participation using existing programs and will be considered as **SECONDARY** alternative to be implemented on a voluntary basis by others if desired. This alternative is also inconsistent with other natural resource plans (i.e. Prairie Plan) for this area.	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future Conversion to Forest in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis, the cost per ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio.	Forestland produces much less rainstorm runoff than cultivated cropland. A typical reduction is estimated to be about 55%. Using NRCS runoff estimating procedures, it can be shown that the greatest reduction in storm runoff is achieved on lighter soils such as sandy or silty loams. The effects on snow accumulation and spring snowmelt runoff from forestland have not been well documented.	Secondary
e) Other Beneficial Uses of Stored Water (domestic, industrial, streamflow augment,…)	+	++	++	Not Practicable as a primary alternative for further analysis based on: 1, 2, 3 and 4. The primary reasoning is Item 3 - Technical Feasibility. This will be considered a **SECONDARY** alternative in conjunction with other primary strategies (i.e. impoundments,…) because implementation would be dependent upon the operation of other facilities (flood control portions of the impoundment - i.e. level of drawdown).	Criteria 1 - Presently there is not a reasonable expectation of obtaining land for the sole purpose of storing water for domestic, industrial, or stream flow augmentation purposes. However, it may be possible to incorporate these purposes into flood storage projects as secondary benefits. Criteria 2 - There is not enough volume demanded for domestic, industrial, or stream flow purposes in this watershed area to expect the volume stored for these purposes would provide a significant contribution toward reducing the required flood volume and peak flows. Criteria 4 - Since there is no significant demand for storing water for domestic, industrial, or stream flow purposes in this watershed area it is not expected that the public would be willing to pay for projects with this sole purpose.	Stored water can be used for domestic or industrial purposes, or for stream flow augmentation during drier periods of the year to improve fish habitat and provide other instream flow benefits. Use of this water results in drawdown of the reservoir, providing annual removal of water from the spring flood volume.	Secondary

	Red River Timing Zone			Alternative Screening Rationale			
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
2) Increase Conveyance Capacity							
a) Channelization (increasing the flow capacity of existing channels or flowages)	+	-	-	**NOT PRACTICABLE** as a primary alternative for further analysis based on 2 - Position in the Watershed. This alternative will not meet the identified goals/objectives and has the potential to exasperate the problem of downstream flooding through a decrease of floodplain storage, acceleration of flow, and a corresponding increase in local peak flood flows on the channelized stream.		Channelization projects may include enlarging or realigning natural channels or creating channels in areas of diffused or overland flow. Channelization projects are usually done to decrease local flooding. The hydrologic effect is a decrease of floodplain storage, acceleration of flow, and a corresponding increase in local peak flood flows on the channelized stream. . Projects located in early water areas relative to the main stem will tend to	Not Practicable
b) Drainage (creating new or improved conveyance capacity)	+	-	-	**NOT PRACTIABLE** as a primary alternative for further analysis based on 2 - Position in the Watershed. This alternative will not meet the identified goals/objectives and has the potential to exasperate the problem of downstream flooding through a decrease of floodplain storage, acceleration of flow, and a corresponding increase in local peak flood flows.		The primary purpose of agricultural drainage projects in the Red River Basin is to remove excess surface water and soil moisture. This allows the ground to warm up faster in the spring, provides an aerated rooting zone for crop development, and minimizes drowning of crops by excess precipitation. The need for outlets for field drainage led to the development of larger collector ditch systems. Increasing the capacity of a drainage channel will reduce the frequency of adjacent land flooding, but will have a related increase in peak discharge rates immediately downstream. The impact on flood-prone areas farther downstream will depend on relative locations. Removing early water faster will decrease main stem flood peaks. Removing late water faster will increase main stem flood peaks. Determinations of the adequacy of an outlet should consider the effects on downstream flooding, both within and downstream from the drainage system, for various magnitudes of flood events.	Not Practicable
c) Diversion (of flood waters around a current damage area)	+	V a r i a b l e	-	**NOT PRACTICABLE** as a primary alternative for further analysis based on: 2, 3, 4 and 6. The primary reasoning is Item 3 - Technical Feasibility. It will be impractical to divert flows around the damage area identified in the problem statement that included portions of the Green Meadow Subwatershed, Marsh River Watershed and Red River Basin.	Criteria 2 - Based on the position of the Green Meadow subwatershed relative to the identified downstream flood problems along the Marsh River and Red River of the North, it is practical to divert the water from this watershed without having the potential to increase downstream flooding conditions. Criteria 4 - Due to the location of downstream flooding concerns, any diversion of water from the Green Meadow subwatershed would also likely require additional mitigation features (i.e. storage,...) to be added. This would increase the cost substantially. For this reason, it is unlikely that there would be a willingness to pay by the public. Criteria 6 - Without additional mitigative measures added to any diversion project, there is an unreasonable expectation of obtaining permits and necessary approvals. Increasing flood levels downstream is contrary to local, state and federal floodplain and zoning rules.	Diversion projects typically remove water from a flood-prone stream, convey it safely around a significant damage site, and return it to a downstream watercourse. A diversion is an alternative to channelization or protection measures, such as levees and floodwalls, when environmental impacts, cost, or other land use issues are better addressed by this measure. Diversions may include operable controls. Operation can consider upstream, downstream, and local flood conditions. This allows for optimizing benefits while minimizing potential adverse impacts.	
d) Setting Back Existing Levees (to increase conveyance capacity)	+	-	-	**NOT PRACTICABLE** as a primary alternative for further analysis based on 2 - Position in the Watershed. This alternative will not meet the identified goals/objectives and has the potential to exasperate the problem of downstream flooding through a decrease of floodplain storage, acceleration of flow, and a corresponding increase in local peak flood flows.		Levees constructed along flood-prone waterways often restrict conveyance enough to cause a backwater effect by encroaching on the floodway. Moving the levees back farther away from the channel will restore a portion of the lost floodway capacity. Doing so with a primary purpose of increasing conveyance will primarily benefit lands upstream from the levee encroachment. The downstream effects in this situation may include an increase in peak flows, due to the reduction in upstream floodplain storage. However, this may be offset by increased floodplain storage within the setback levee reach.	Not Practicable
e) Increase Roadway Crossing Capacity (increase conveyance potential)	+	-	-	Not Practicable as a primary alternative for further analysis based on: 2, 3, and 6. The primary reasoning is Item 2 - Position in the watershed. This alternative will not meet the identified goals/objectives and would reduce floodplain storage and increase downstream peak flows. This **SECONDARY** alternative will only be considered for further analysis where and if it's localized impacts could off-set by other primary strategies.	Criteria 3 - Increasing roadway crossing capacity to reduce flood damages would need to be done on a widescale basis due to the potential impacts that occur downstream of the increased locations resulting from higher flows. This would involve local, county, and state roadways making the implementation so complex as to create doubt about realizing anticipated benefits. Criteria 6 - Without additional mitigative measures added to increased roadway crossing capacity projects, there is an unreasonable expectation of obtaining permits and necessary approvals. Increasing flood levels downstream is contrary to local, state and federal floodplain and zoning rules.	Road crossings typically restrict conveyance. Often, the road approaches block the floodway on both sides of the channel, and the bridge or culvert is smaller than the channel. In many cases, this is not a problem because the effect of the bridge constriction does not extend far upstream. However, in flatter areas of the Red River Basin, roads, bridges, and culverts can be a major factor affecting upstream flood elevations, due to backwater effects. In areas where the upstream flood damage potential is high, some of the lost conveyance can be restored by increasing bridge or culvert size. Another method, which may be less expensive, is to lower the approach road grades to allow for overtopping at an elevation lower than a critical upstream flood damage point (provided traffic safety concerns are adequately addressed). Increasing road crossing capacity may increase downstream peak flows, due to reduction in upstream floodplain storage.	Seconday
3) Increase temporary Flood Storage							

	Red River Timing Zone				Alternative Screening Rationale		
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
a) Gated Impoundments (longer-term detention of water in excess of downstream channel capacity)	+	++	++	**PRIMARY** alternative carried forward for further analysis due to it's potential to meet the identified needs, goals and objectives.		Impoundments are reservoirs constructed to temporarily store (impound) floodwater. The most important consideration from an overall flood control standpoint is the timing of the storage and release. The design and operating goal should be to store water that would otherwise contribute to downstream flood peaks and to avoid causing damages during the subsequent release of the stored floodwater. In relation to maximizing downstream benefits, impoundments are most effectively located in the middle and late areas of the basin. Impoundments located in a late area should be designed to store the early water on the rising limb of the local hydrograph to help reduce main stem peak flows. Impoundments located in a middle area should be designed to store the peak of the local hydrograph. Impoundments located in early areas of the basin may also be beneficial to the main stem, if they are designed to store the falling limb of the local hydrograph. This would usually require either a very high capacity storage site to store all of the floodwater, or high capacity gate works that can pass the early flows and be closed to store the late flows. This also requires substantial flood monitoring and prediction capability.	Primary
b) Ungated Impoundments (shorter-term detention of water in excess of downstream channel capacity)	-	++	++	**PRIMARY** alternative carried forward for further analysis forward due to it's potential to meet the identified needs goals and objectives.		Impoundments are reservoirs constructed to temporarily store (impound) floodwater. The most important consideration from an overall flood control standpoint is the timing of the storage and release. The design and operating goal should be to store water that would otherwise contribute to downstream flood peaks and to avoid causing damages during the subsequent release of the stored floodwater. In relation to maximizing downstream benefits, impoundments are most effectively located in the middle and late areas of the basin. Impoundments located in a late area should be designed to store the early water on the rising limb of the local hydrograph to help reduce main stem peak flows. Impoundments located in a middle area should be designed to store the peak of the local hydrograph. Impoundments located in early areas of the basin may also be beneficial to the main stem, if they are designed to store the falling limb of the local hydrograph. This would usually require either a very high capacity storage site to store all of the floodwater, or high capacity gate works that can pass the early flows and be closed to store the late flows. This also requires substantial flood monitoring and prediction capability.	Primary

	Red River Timing Zone			Alternative Screening Rationale			
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
c) Restored or Created Wetlands (functioning as impoundments)	-	+	+	This strategy was originally carried forward for further analysis due to it's potential to meet the identified needs, goals and objectives. However, based on further review of the Existing Depressional Areas in the subwatershed area using the RRBDIN Watershed Planning Tool (WPT), it was determined that there was only a small number of existing depressions currently exist in the watershed that would exceed more than 5-10 acres in size. Based on this additional information, this strategy was **NOT PRACTICABLE** as a primary alternative for further consideration based on: 1, 2, 4 and 6. The primary reason for eliminating the alternative was Item 6 - Logistics. This alternative will require voluntary participation using existing programs (WRP, RIM, CRP…)and will be considered as a secondary alternative to be implemented on a voluntary basis by others (SWCD, NRCS, etc.).	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future projects in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis (due to concerns about limiting bounce to minimize vegetative impacts), the cost per ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio.	Wetlands are restored or created for a variety of reasons, which may include providing temporary flood storage. The distinguishing characteristic of a flood storage wetland will usually be a restricted capacity, or gate-controlled, outlet. The restriction may be a small pipe, orifice, or notched outlet. The controlled outlet may have a lift gate or stop log bay. In general, stop logs provide the best level control during non-flood periods because they function as an adjustable overflow weir. Compatibility with other wetland purposes may limit the amount of water level rise (bounce) that can be tolerated. For typical multipurpose wetlands, TSAC Technical Paper No. 1, "An Overview of the Impacts of Water Level Dynamics ("bounce") on Wetlands," suggested that bounce should be limited to about 2 feet during a 10-year, 24-hour summer rain storm event and most of the bounce water should be removed within 10 days to minimize impacts to vegetation and wildlife habitat. Spring flood bounce generally can be greater than indicated above without adverse impacts, provided the water levels are returned to normal by early in the growing season. Wetlands with temporary flood storage are most beneficial for main stem flood control when located in middle and late contributing areas of the basin.	Not Practicable
d) Drainage (to lower surface water and groundwater levels, which increases infiltration and temporary storage in the upper soil horizons)	-	+	+	**NOT PRACTICABLE** as a primary alternative for further consideration based on: 1, 2, 4 and 6. The primary reasoning are items 6 - Logistics and 4 - Technical Feasibility. This alternative will require widespread voluntary participation by many landowners and require unreasonably complex operation to meet the goals and objectives. However, this secondary alternative will be considered for implementation where feasible on a voluntary basis.	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future Drainage for this purpose in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas.	In areas where the ground is saturated, its ability to absorb and retain water may be enhanced by surface or subsurface drainage. From a flood control standpoint, this is done most effectively by installing seepage tile to lower the water table. If the tile is moderately sized, its subsurface drainage rate will be small compared to surface runoff, contributing little to downstream peak flows, and the increased soil storage capacity will reduce surface runoff. It is important to understand the context wherein this measure will be beneficial for downstream flood control. Everything else being equal, subsurface drainage measures will produce lower peak outflow rates than surface drainage measures, because of increased storage capacity in the soil and more limited flow capacities. However, the peak flow reduction benefits may be overshadowed if adding subsurface drainage is accompanied by change in land use that increases runoff potential or by loss of depressional storage. The most appropriate application for drainage is on existing agricultural land where a high water table restricts the crop rooting depth. The additional temporary storage capacity provided will be most beneficial for main stem peak flow reduction when implemented in middle and late areas relative to the main stem	Not Practicable
e) Culvert Sizing (to increase temporary storage by widespread metering of runoff close to its source)	-	+	+	This strategy was originally forward for further analysis due to it's potential to meet the identified needs, goals and objectives. However, based on further review of the Potential Storage - Existing Roads in the subwatershed area using the RRBDIN Watershed Planning Tool (WPT), it was determined that there was only a small number (3-5) of existing roadways in the watershed that would provide more than 200 acre-ft of storage behind them and not impact existing building sites. Based on this additional information, this strategy was **NOT PRACTICABLE** as a primary alternative for further consideration based 1, 2 and 3. The primary reason was Item 3 - Technical Feasibility based on it not being physically possible to implement meaningful widespread culvert sizing to obtain the project goals. However, this alternative will be considered as secondary to be implemented on a voluntary basis by the various road authorities.	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future projects in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas.	Culvert sizing is a technique that can be used to control runoff rates. By appropriately sizing road and drainage system culverts throughout a subwatershed or watershed, the flow rates can be regulated to better match downstream channel capacities. Excess water is temporarily detained upstream from culverts. This approach can provide a more consistent level of protection throughout a drainage system. If properly done, it should also result in reduced road repairs and increased traffic safety. At some locations, road safety may dictate using two stage inlets, raising the road grade, or taking other measures to prevent overtopping. Culvert sizing provides relatively short-term storage. It is most effective in reducing main stem flooding if implemented in middle and late contributing areas of the basin.	Not Practicable

	Red River Timing Zone				Alternative Screening Rationale		
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
f) Setting Back Existing Levees (to increased floodplain storage)	+	++	+	This strategy was originally carried forward for further analysis due to it's potential to meet the identified needs, goals and objectives. Restoring a portion of the lost floodplain storage could benefit downstream areas by helping to attenuate flood peaks. However, based on further review using the RRBDIN Watershed Planning Tool (WPT), it was determined that the only leveed reach that current exists is in Sections 7-9 of Green Meadow Township. Currently this corridor has widths of up to approximately 800-ft in some areas. Even if these levees were setback to 1200-ft throughout this entire 3 mile corridor, due to the landslope we would only expect a small volume of floodplain storage to be restored. Based on this additional information, this strategy was **NOT PRACTICABLE** as a primary alternative for further consideration based on Items 1, 2, 4 and 6. However, this alternative will be considered as secondary to be considered for additional NR benefits.	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future projects in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis the cost per effective ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio. Criteria 6 - Based on the high costs associated with land prices, there is not a reasonable expectation of obtaining the financial resources necessary for implementation for the sole purpose of providing additional floodplain storage.	Levees are constructed to protect floodplain areas from flooding. Doing so reduces the amount of floodplain storage that otherwise helps to naturally attenuate downstream flood peaks. Moving existing levees back, farther away from the channel, will restore a portion of the lost floodplain storage, benefiting downstream areas by helping to attenuate flood peaks. However, there may be a corresponding negative effect on downstream areas, due to increased floodway capacity that decreases backwater effects and may reduce upstream floodplain storage.	Not Practicable
g) Overtopping Levees (to utilize diked floodplain storage capacity when critically needed)	++	+	Variable	This strategy was originally carried forward for further analysis due to it's potential to meet the identified needs, goals and objectives by better utilizing portions of the lost floodplain storage to attenuate flood peaks and benefit downstream areas. However, based on further review using the RRBDIN Watershed Planning Tool (WPT), it was determined that the only leveed reach that current exists is in Sections 7-9 of Green Meadow Township. Installation of overtopping levees in this area would only allow for minimal flood storage due to the landslope in the area and level of existing roadways. This was verified based on further review of the Potential Storage - Existing Roads in the subwatershed area using the RRBDIN Watershed Planning Tool (WPT) Based on this additional information, this strategy was **NOT PRACTICABLE** as a primary alternative for further consideration based on Items 1, 2, 4 and 6. However, this alternative will be considered as secondary to be considered for additional NR benefits.	Criteria 1 - Presently there is not a reasonable expectation of obtaining land. This strategy would require voluntary participation by individual landowners for areas that would be inundated when the levees are overtopped. Criteria 2 - Since this alternative would be implemented on a voluntary basis, the position of the future projects in the watershed relative to the problem area is uncertain. In addition, it is unlikely that enough voluntary participation would occur to provide a significant change in the contribution of peak flow and runoff volume to the problem area from the from the participating areas. Criteria 4 - Since these projects would provide relatively small incremental flood damage reduction on a per acre basis the cost per effective ac-ft of flood storage would be high compared to other traditional flood storage projects due to the small storage/land ratio. Criteria 6 - Based on the high costs associated with land prices, there is not a reasonable expectation of obtaining the financial resources necessary for implementation for the sole purpose of providing additional floodplain storage.	Floodplain areas gradually fill on the rising limb of a flood hydrograph and gradually empty on the falling limb. Therefore, much of the floodplain storage capacity is used up before the flood peak, and much of that storage is released while flooding is still occurring downstream. Overtopping levees are most effective when located at or near the area that needs protection, because proper timing of the storage is automatically provided. These levees will be most beneficial for the main stem when located in early and middle runoff timing areas of the basin.	Not Practicable

	Red River Timing Zone						
				Alternative Screening Rationale			
FLOOD DAMAGE REDUCTION ALTERNATIVE	**Early**	**Middle**	**Late**	**Primary Rationale**	**Secondary Rationale**	**Alternative Description**	**Final Designation**
4) Protection/Avoidance							
a) Urban Levees (community protection)	-	-	-	**NOT PRACTICABLE** as a primary alternative for further analysis since it does not address an identified need, goal or objective.		Urban levee construction should be carefully considered. Levees can create a false sense of security that may lead to unwise development within the protected floodplain area. Levees have the potential for catastrophic failure with rapid inundation of the protected area. Levees may raise flood elevations upstream, due to constriction of the floodway, or downstream, due to loss of floodplain storage. Levees may be appropriate to protect flood-prone urban areas at any location within the basin. However, this FDR measure is most appropriately used where other options that benefit more than just the levee-protected area are not available. When used in conjunction with temporary flood storage and/or flood runoff reduction, the height and cost of the levee can be reduced and the level of protection of the leveed area increased.	Not Practicable
b) Farmstead Levees (rural property protection)	-	-	-	**NOT PRACTICABLE** as a primary alternative for further analysis because it does not address an identified need, goal or objective.		Farmstead levees are similar to urban levees except that the area protected typically is small and located within a rural floodplain or floodway. Farmstead levees are often referred to as "ring dikes" because they are normally constructed as a dike that completely surrounds the farmstead.	Not Practicable
c) Agricultural Levees (agricultural property protection)	-	-	-	**NOT PRACTICABLE** as a primary alternative for further analysis based on: 2, 3, and 6. Primary reasoning is Item 2 - Position in the watershed. This alternative will not meet the identified need, goal or objective and it will reduce floodplain storage and increases in downstream peak flows.	Criteria 3 - Adding agricultural levees protect agricultural areas was not considered technically feasible due the extensive length of levees needed to protect the identified damage areas and the fact that they would result in an increased flow downstream requiring additional mitigative measures. Criteria 6 - Without additional mitigative measures added to agricultural levee projects, there is an unreasonable expectation of obtaining permits and necessary approvals. Increasing flood levels downstream is contrary to local, state and federal floodplain and zoning rules.	Agricultural levees protect entire fields, or agricultural areas, and have been built extensively within the Red River Basin. In many cases, they have been implemented by simply installing flap gates on culverts under road embankments or ditch spoil banks. Levees can easily protect agricultural land from frequent smaller floods. This is especially useful where ditch overflows might cause serious field erosion. However, protecting agricultural land from flooding can substantially increase downstream flood flows, due to loss of floodplain storage and/or constriction of a floodway. The most important consideration in the application of agricultural levees is the overtopping elevation. In general, the levees will cause an increase in all flood peaks up to the overtopping elevation and a decrease in all flood peaks above that elevation.	Not Practicable
d) Evacuation of the Floodplain (removing flood prone property)	NA	NA	NA	**NOT PRACTICABLE** as a primary alternative for further analysis based on: 1, 4, and 6. Primary reasoning is Item 4 - Willingness to Pay and Cost. This alternative was Not Practicable due to the expected high costs of evacuation of the identified damage areas.	Criteria 1 - Presently there is not a reasonable expectation of obtaining property required for evacuation. This strategy would require voluntary participation by individual landowners. Criteria 6 - Based on the high costs associated with acquiring flood prone property, there is not a reasonable expectation of obtaining the financial resources necessary for implementation.	Some areas of the floodplain are so low that they flood frequently, or are very difficult to protect. In these areas, it may be more practical to eliminate uses of the floodplain that are incompatible with flooding. In urban areas, this means removing residential, commercial, and industrial development, along with the associated infrastructure, from at least portions of the floodplain. The evacuated areas may be converted to parkland or greenways, thereby enhancing the urban environment. In agricultural areas, this means removing farmsteads and converting existing cropland to flood tolerant agricultural or non-agricultural use. Establishing greenbelt corridors along flood-prone streams is an example of environmentally beneficial, non-agricultural use. Converting from annual crops to perennial grasslands or forests, or other water-tolerant species, such as wild rice, are examples of agricultural conversions to reduce flood damage potential.	Not Practicable
e) Flood proofing (raising property and flood resistant materials)	NA	NA	NA	**NOT PRACTICABLE** as a primary alternative for further analysis based on: 1, 4, and 6. Primary reasoning is Item 4 - Willingness to Pay and Cost. This alternative was Not Practicable due to the high d costs of flood proofing the identified damage areas.	Criteria 1 - Presently there is not a reasonable expectation of obtaining property required for evacuation. This strategy would require voluntary participation by individual landowners. Criteria 6 - Based on the high costs associated with flood proofing flood prone property, there is not a reasonable expectation of obtaining the financial resources necessary for implementation.	Flood proofing means making flood-prone property resistant to damage. It includes raising buildings and essential access routes above the flood level and using flood resistant materials or construction techniques. This measure may be appropriately applied in any flood-prone area of the basin where it is feasible, because it typically will not significantly affect downstream flood peaks.	Not Practicable
f) Warning and Emergency Response (notification processes)	NA	NA	NA	**NOT PRACTICABLE** as a primary alternative for further consideration since it does not address an identified need, goal or objective.		Flood warning and emergency response planning are an established flood damage reduction method in the Red River Basin. They begin with long- and short-term forecasts of flood potential and lead to sandbagging, earthen levee construction, or other emergency protection methods, and ultimately evacuation, if necessary. Flood forecasting has become more accurate with experience and improved monitoring and forecasting techniques. However, the ability to accurately predict floods, especially those larger than previously experienced, should not be depended on. Emergency response plans must include the ability to react to changing conditions. Most important is having a mechanism for determining when to fight the flood and when to evacuate.	Not Practicable