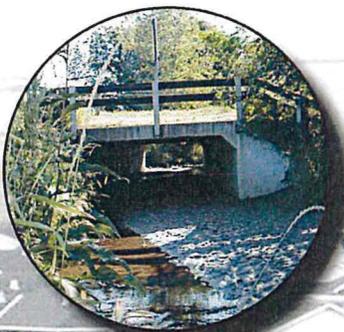


Bismarck

Tyler Coulee Storm Water Master Plan



Presented to:
City of Bismarck, ND

Presented By:
Houston Engineering, Inc.
Bismarck, ND

February, 2007





TYLER COULEE STORM WATER MASTER PLAN CITY OF BISMARCK

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Acknowledgements

The City of Bismarck and Houston Engineering, Inc. would like to acknowledge the participation of the following agencies in the development of the *Tyler Coulee Storm Water Management Plan*.

Burleigh County Water Resource District
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Bismarck, North Dakota 58501

Bismarck Parks and Recreation District
Steve Neu, Director
400 East Front Avenue
Bismarck, ND 58501

The following individuals attended and participated in the Citizen Advisory Work Groups established for Alternative Development and Financing representing neighborhood, local and community interests.

- Craig Bleth
- David Bliss
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- Fay Connell
- Gene Duchsherer
- Brian Eiseman
- Bob Entringer
- Robert Fischer
- Kyle Forster
- Al Frank
- Carolyn Frank
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- Kent Hauge
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- Scott Hopfauf
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- Don Jensen
- George Keiser
- Fred Kraft
- Les Larson
- Paul Maddock
- Harvey Melstad
- Kelly Moldenhauer
- Ed Murphy
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- Donna Schauer
- Robert Schauer
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- Anita Thomas
- Kevin Thomas
- Scott Wegner
- John Westbee

The C-Family Trust, a stakeholder and major landowner within the watershed represented by William Clairmont, also participated in the process.

A Special Thank You to Commissioner Connie Sprynczynatyk who served as the Work Group Facilitator; Mel Bullinger, City Engineer; Lisa Ansley, Project Engineer; Keith Demke, Director of Utility Operations, and their staffs, and Bill Wocken, City Administrator.

Tyler Coulee Watershed

Storm Water Master Plan



1.0 INTRODUCTION

Houston Engineering, Inc. (HEI) was retained in November 2003 by the City of Bismarck (City) to update the *July 2002 Tyler Coulee Storm Water Assessment and Management Plan* (2002 Report). The intent was to first review project alternatives, and then to expand both the definition and level of detail available in order to provide preliminary level cost opinions for the projected regional (i.e., trunk line) storm water facilities required to service the needs in this watershed. The location of this watershed in relation to the City of Bismarck is illustrated on **Figure 1.0**. This master plan update contains a number of evaluation sites and analyses as outlined in the following sections, which are supplemented by the report appendices. A copy of the 2002 Report is contained on the CD included with this plan document.

1.1 Study Purpose

Hydrological conditions within the Tyler Coulee Watershed are undergoing significant changes associated with continued urbanization. Development pressures within this watershed have significantly increased in recent years, with major changes expected within the next few years. Current land uses range from undeveloped pasture or grassland to large areas of principally single family residential within the eastern and northeastern portions, to commercial development located in the southeast near Interstate #94.

This report addresses the general issues associated with potential development within flood prone areas, controlling adverse impacts resulting from additional runoff generated by new urban development, and the need to identify future regional storm water management facilities. The City of Bismarck's Storm Water Ordinance requires that all new plat submittals include a storm water management plan. It is difficult, however, for individual parcel owners or developers to account for the cumulative impacts within a larger watershed and/or regional development activities. This master plan provides a guide to limit and/or prevent avoidable impacts. This is accomplished by defining a preferred alternative for the primary trunk line or regional facilities necessary to convey or accommodate runoff generated intermediate and by ultimate development conditions.

Master planning requires that various assumptions be made in order to evaluate future watershed conditions. These include projecting the type of development within each subwatershed, probable street layouts, storm sewers, culverts, and related surface water management features.



All the storm water management facilities outlined in this master plan are based on conceptual assumptions, which can and will change to some extent as actual planning and development continues. Therefore, caution is advised as this master plan provides a broad based perspective, and is not intended to replace local site-specific evaluations required under the City's planning permitting process. It is recommended the City update this master plan and the SWMM hydrologic models as necessary to evaluate specific developments as they are submitted. A current zoning map for this watershed, as obtained from the City Planning Department, is illustrated on **Figure 1.1**.

1.2 Stakeholder Meetings

HEI held individual meetings with two designated major stakeholders; the Bismarck Parks and Recreation District (BPRD) and the C-Family Trust. Each of these major stakeholders had a significant and specific interest in the location, costs and impacts associated with the future regional storm water facilities within the watershed. The minutes for these stakeholder meetings are contained in **Appendix A**.

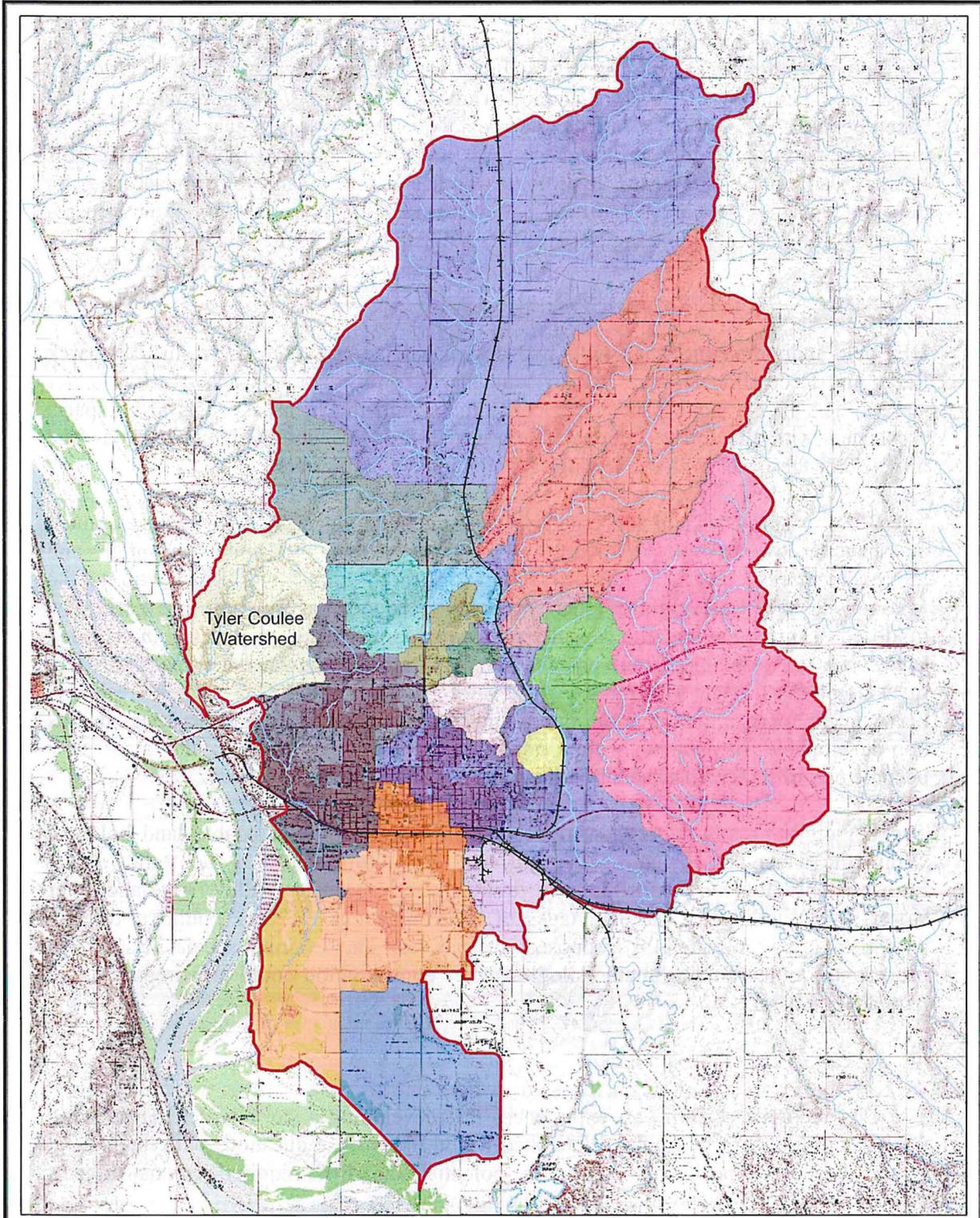
The BPRD is interested and concerned with the potential impacts that future development may have on Pioneer Park. In 2002 the BPRD completed major channel renovations and improvements, via a FEMA disaster mitigation grant, from River Road west to the Missouri River to prevent the recurrent flooding and damages within the park. The modified channel now has the capacity to convey approximately a 2-year 6-hour flood event prior to overtopping south into the park. Any changes in watershed hydrology that may affect this system's adequacy are a concern. The BPRD was also interested in knowing the location and area of land within the watershed that might be designated as non-developable or located within non-development zones, which ultimately may become part of the green space or park system.

The C-Family Trust's interests were related principally to their sizable land holdings within the watershed, including the existence and future status of the Valley Drive Embankment, Golf Drive Corridor and future stream crossings. Valley Drive and other storm water facilities in various stages of development at the time could be directly and/or indirectly affected by proposed alternatives. The existing special assessment process and other funding methodologies under consideration could also impact future land development.

1.3 Public Involvement

The City recognized from past experiences that developing a storm water management project within the Tyler Coulee Watershed would likely raise questions with the general public. This was especially true given the potential size of the required regional projects and the nature of currently available financing methods.





Tyler Coulee Watershed

FIGURE 1.0 - LOCATION MAP

Legend

- Streams
- Railways
- Bismarck Watershed Coverage

Name	Color
Capitol Avenue	Light Pink
Centennial	Light Green
Hay Creek	Dark Blue
Hay Creek HC 3-3, 4-6, 5-3	Red
Jackman Coulee	Dark Blue
Landfill	Pink
North 19th Street	Purple
North 4th Street	Blue
North Valley	Orange
North Washington Street	Green
Pebble Creek	Dark Red
Shannon Valley	Light Green
Skoven Slough	Light Blue
South 12th Street	Dark Blue
South Bismarck	Light Purple
Tyler Coulee	Yellow
US Health Care	Dark Green

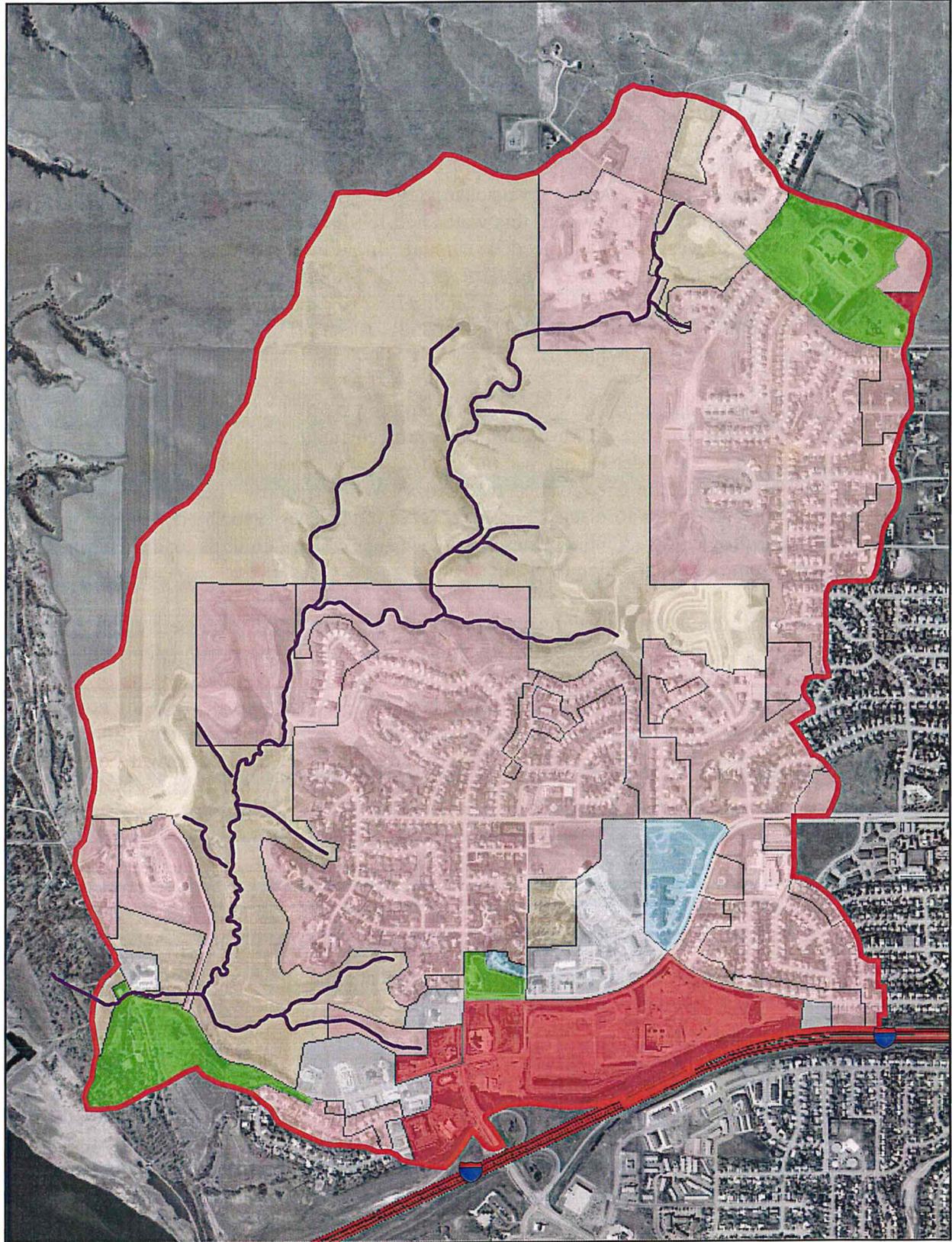
Orthoquad Source: USGS
 Data Source: NRCS & ND GIS Hub

**TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA**

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Q:\GIS\Projects\City of Bismarck\Tyler Coulee\Figure 1.0 Location Map.mxd

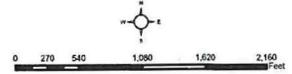


- Major Watershed Boundary
- Stream Channel (digitized by Houston Engineering)
- Major Roads**
- Interstate
- State Highway
- US Highway

- Zoning Districts**
- Agricultural
- Commercial
- Residential
- Health-Medical
- Industrial
- Public Use
- Planned Unit Development
- Office/Multi-Family Residential

**Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota**

**FIGURE 1.1
EXISTING ZONING**



Orthophoto Source: City of Bismarck
Date of Photography: April 25, 2001
Data Source: City of Bismarck

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The first public information meeting facilitated by HEI was held on February 5, 2004 to present the master planning process, to gauge public awareness and sentiments, as well as to gather input and insight on the community's opinion relative to future development within the Tyler Coulee Watershed. It was clearly evident from the meeting that a sizable segment of the residents living within this watershed felt the current storm water project finance mechanism was unfair and needed revision. In addition citizens voiced various concerns related to the overall costs of large regional projects, and the distribution of these costs to the benefited properties. Summaries of this and subsequent public meetings are contained in **Appendix B**. This appendix is not printed with this report, but is contained on the accompanying CD.

The City held a second public informational meeting on April 12, 2004 without HEI in attendance, for the purpose of discussing the project finance questions and related development issues. In order to increase public involvement in the master planning and finance review process the City formed two Citizen Work Groups. These groups were assigned to selected topics to discuss and address various issues associated with master planning and project financing. These work groups, their findings and resulting recommendations are discussed in **Section 2.0**.

A final public informational meeting was held December 6, 2004 to present the work group findings and the Preferred Alternative to be included in the master plan report. This meeting incorporated presentations on the successes and recommendations of the work groups, an outline of the project alternatives as well as opinions of probable costs. The City based on input from the two work groups also presented a recommendation for proposed revisions to the project finance process that were to be carried forward to the City Commission for consideration. More information on the financial issues and this revision are presented in **Section 5.0**

2.0 CITIZEN WORK GROUPS

As noted in **Section 1.3** the City established two Citizen Work Groups to review the various aspects of master plan development and project financing. These work groups were comprised of volunteers who were either residents and/or landowners living within the watershed, or individuals representing various landowners, developers and/or other interests. Each work group focused on various project elements as described in the following sections. Their meetings were facilitated by a City representative and City staff, with the assistance of and presentations by HEI and other requested parties to provide information pertinent to the issues under discussion. Additional information related to this process including a listing of participants, meeting minutes, and a summary of each group's findings is contained in **Appendix C**.



2.1 Master Plan Work Group

The *Master Plan Work Group* (MPWG) was charged with reviewing information and analyses associated with the master plan components prepared by HEI. The MPWG held five meetings and reviewed a number of master plan alternatives, including but not limited to those contained within the 2002 Tyler Coulee Master Plan, updated or additional proposed detention/retention locations, projected breach/flood hazard areas, benefited areas, proposed development control lines, topographic and geotechnical concerns, best management practices, green space, steep slopes, potentially undevelopable lands, and issues regarding the definitions for “regional” or “local” storm water management facility. Since it was difficult at times to differentiate between alternative review and project costs, the MPWG held a joint meeting with the Finance Work Group to discuss this issue. The storm water management alternatives included conceptually configured detention/retention facilities that would comply with the various regulatory requirements and applicable design standards.

The basic focus of the MPWG can be summarized into the following topics:

- Storm Water Management Systems
 - Layout and Functionality
 - Alternative Configuration and Benefits
- Local vs. Regional Systems and Definitions
- Development Control Line (Tier One and Tier Two)
 - Breach/Flood Zone
 - Undevelopable Lands
- Best Management Practices

Each of these topics is addressed in the various sections of this master plan report and its appendices.

2.2 Finance Work Group

The *Finance Work Group* (FWG) was charged with reviewing available funding and/or finance methods currently utilized and/or available to construct storm water management facilities. In addition they considered other potential methodologies, not currently in place, that merited further consideration for review and implementation. A brief summary of the finance methods evaluated are as follows:

- Storm Water Improvement District (SID) – Special Assessment District
- Storm Water Utility Revisions – Community Paid Fee
- Storm Water Development/Impact Fee – Developer Paid Fee
- Water Resource District – Drainage Project Assessment District
- Sales Tax – Community Based
- Grants – State, Federal or Local
- General Mill Levy Tax Revenues



Each methodology was weighed and considered based on the pros and cons associated with its use and implementation. The principal focus being the equitable distribution of costs as they relate to the benefits provided. Considerable discussions also occurred relative to the definition or differentiation between a regional or local facility. Regional facilities being typically paid for by a larger landowner base or assessment district; while local projects are typically paid directly by the developer.

The background issues associated with each financing method is lengthy and not documented here. Various elements of each, however, are noted within the work group meeting minutes. After considering all these methods City staff developed and presented, with the consensus of both work groups, a recommendation to the City Commission to revise the current financing process, which is further summarized in **Section 5.0**.

One issue of special interest addressed during the FWG and MPWG meetings was future development and related costs for any project located within what is known as the Golf Drive Corridor. A 1996 project proposal for a storm water assessment district met with considerable community resistance and controversy. The project was eventually pulled from further consideration by the developer. While reviewing the Golf Drive Watershed it was concluded that this area should be considered as a separate project and benefiting area. As such future costs for regional storm water conveyance systems constructed within this corridor should not be assessed to other portions of the Tyler Coulee Watershed. The confluence of these two watersheds is located at Clairmont Road. Any projects downstream from this point would be open to assessment to both watersheds. A map illustrating the division between these watersheds is shown in **Figure 2.2.1**.

Due to the construction of the storm water management facilities associated with the Pinehurst Square retail development considerable changes have occurred in the storm water conveyance needs within the Golf Drive Corridor. The revised runoff conditions and project needs are described in **Section 4.7**.

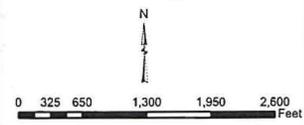
3.0 PROJECT ALTERNATIVE DEVELOPMENT

The development of project alternatives took a number of paths and directional changes throughout the master planning and work group meeting process. Early on, however it became evident that the dam safety issues and jurisdictional requirements of the North Dakota State Engineer (NDSE) were the most critical design compliance issue in the final concept plan and analyses for regional storm water facilities. The details of the subsequent analyses and the preliminary design components for the Preferred Alternative systems are contained in the following appendices and as briefly described herein.

Appendix D – Valley Drive and Morgan Court Facilities
Appendix E – Jurisdictional Technical Memorandum



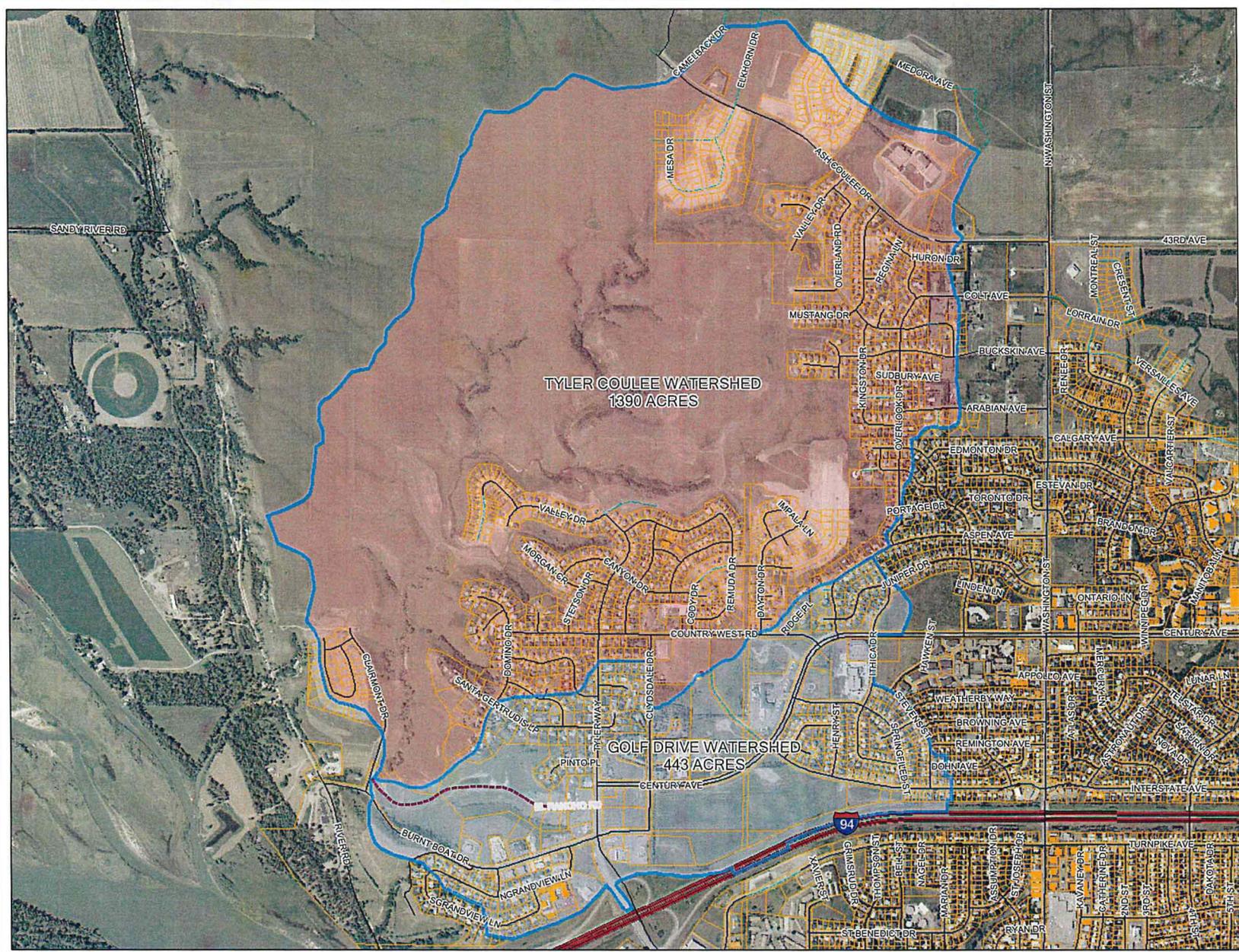
**Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota**



Legend

- Total Watershed
- Golf Drive Watershed
- Tyler Coulee Watershed
- Parcels
- Interstate
- State Highway
- US Highway
- Golf Drive Drainage Corridor

**FIGURE 2.2.1
GOLF DRIVE WATERSHED MAP**



Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & ND GIS Hub

TYLER COULEE & GOLF DRIVE WATERSHEDS

Scale: AS SHOWN	Drawn by: MKB	Checked by: MHG	Project No.: 4489-000	Date: 3-23-05
		Houston Engineering, Inc. 3112 LYONBRI STREET BISMARCK, NORTH DAKOTA 58503		

A summary of the planning and alternative development process are generally outlined in the following sections, with additional background information obtained from and contained within the 2002 Report.

3.1 Hydrology and Hydraulics

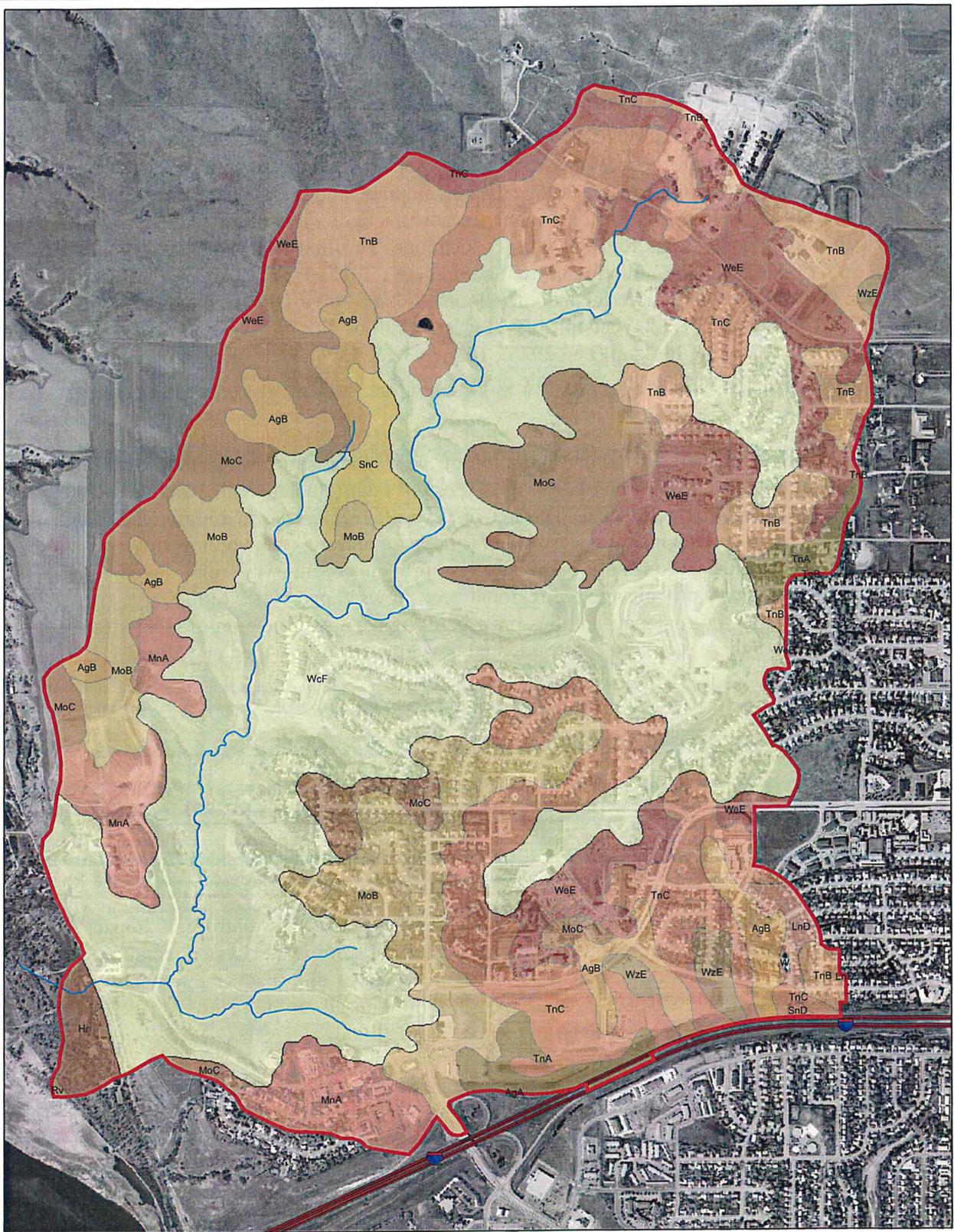
The hydrological and hydraulic analyses for the proposed master plan facilities contained in the 2002 Report were the basis for the initial review and consideration for new storm water management facility alternatives. The master planning process focused on the regional project alternatives and compliance with the dam safety criteria as outlined in the NDSE's Dam Design Manual. Several of the proposed storm water detention and/or retention structures are jurisdictional and thus based on classification must comply with these criteria. This classification is based on the embankment's size, potential loss of life if a breach failure occurs, and its location within an urbanized environment. Subsequently, both the Valley Drive and Tyler Parkway embankments are considered high-hazard facilities. As such they were configured in each alternative to pass a one-half Probable Maximum Precipitation (0.5PMP) event through a structural spillway without overtopping, which is a dam safety design criteria specifically required for these high hazard facilities as defined in the North Dakota Hydrology Manual. A breach analysis was also completed, as is required, to define the potential high risk flood hazard areas along Tyler Coulee.

A more detailed description of the hydrology and hydraulics for the proposed facilities is provided in **Appendix D**. **Appendix E** addresses questions related to the jurisdictional determination as the formal status for several structures remains to be formally established. **Section 4.0** also provides limited descriptions for each project component. The 2002 SWMM hydrological model developed for this watershed was refined and then utilized to complete an alternative feasibility analyses. The following sections outline the basis for the hydrology and hydraulics elements utilized in the watershed analysis.

3.1.1 Burleigh County Soils Survey

The Burleigh County Soil Survey indicates that the majority of the soils located within this watershed are either defined as Type B or Type D. The B-Soils are located on the upper plateaus and lesser slopes, while the D-Soils are located at or below the bluff-line within the tributaries and along the primary Tyler Coulee Channel. While the specific soils types are illustrated on a GIS based mapping, **Figure 3.1.1.1**, a comparison between the distribution of B and D soils is illustrated by noting the predominance of D-soils. Generally D-Soils are very susceptible to erosion both from the forces of wind and water, therefore, the management and control of the uses on these soils is critical. Additional information on the various soil types within this watershed and the protection of the tributary conveyance features and main channel is discussed in **Section 6.0**.





- Legend**
- Major Watershed Boundary
 - Stream Channel
 - Major Roads**
 - Interstate
 - State Highway
 - US Highway
- | | |
|--|--|
| <ul style="list-style-type: none"> ARNEGARD AND GRASSNA SILT LOAMS, GENTLY SLOPING (B) ARNEGARD AND GRASSNA SILT LOAMS, LEVEL (B) HAV/RELON SILTY CLAY LOAM (B) LINTON-MANDAN SILT LOAMS, HILLY (B) MANDAN SILT LOAM, LEVEL (B) MANDAN-LINTON SILT LOAMS, ROLLING (B) MANDAN-LINTON SILT LOAMS, UNDULATING (B) RIVERWASH | <ul style="list-style-type: none"> SEN SILT LOAM, HILLY (B) SEN SILT LOAM, SLOPING (B) TEMVIK SILT LOAM, NEARLY LEVEL (B) TEMVIK SILT LOAM, ROLLING (B) TEMVIK SILT LOAM, UNDULATING (B) WERNER COMPLEX, STEEP (D) WERNER-MORTON-SEN COMPLEX, HILLY (D-B) WILLIAMS-ZAHL LOAMS, HILLY (B) |
|--|--|

**FIGURE 3.1.1.1
GIS SOILS MAP**

**TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA**

Scale: AS SHOWN	Drawn by: MRS	Checked by: MHG	Project No.: 4489-000
			Date: 3-28-06
			Sheet: 1 of 1

0 550 1,100 2,200 Feet

Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & ND GIS Hub

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3.1.2 Land Use Planning Projections

It was noted earlier that master planning requires various land use assumptions to evaluate future runoff conditions. As such consideration was given to various recommendations relative to the allowable development density, cluster development, low density residential estates, best management practices directed at reducing runoff, and special considerations for high density locations. The first level analysis was based on existing development, utilizing current zoning (i.e., 2005) **Figure 3.1.2.1**. The second level analysis considered intermediate development based on a 10 year planning horizon (i.e., 2015), **Figure 3.1.2.2**. The third level was for full or ultimate development is based on a 20 year planning horizon (i.e., 2025), **Figure 3.1.2.3**. The actual development time line is expected to vary due to economic or other market conditions.

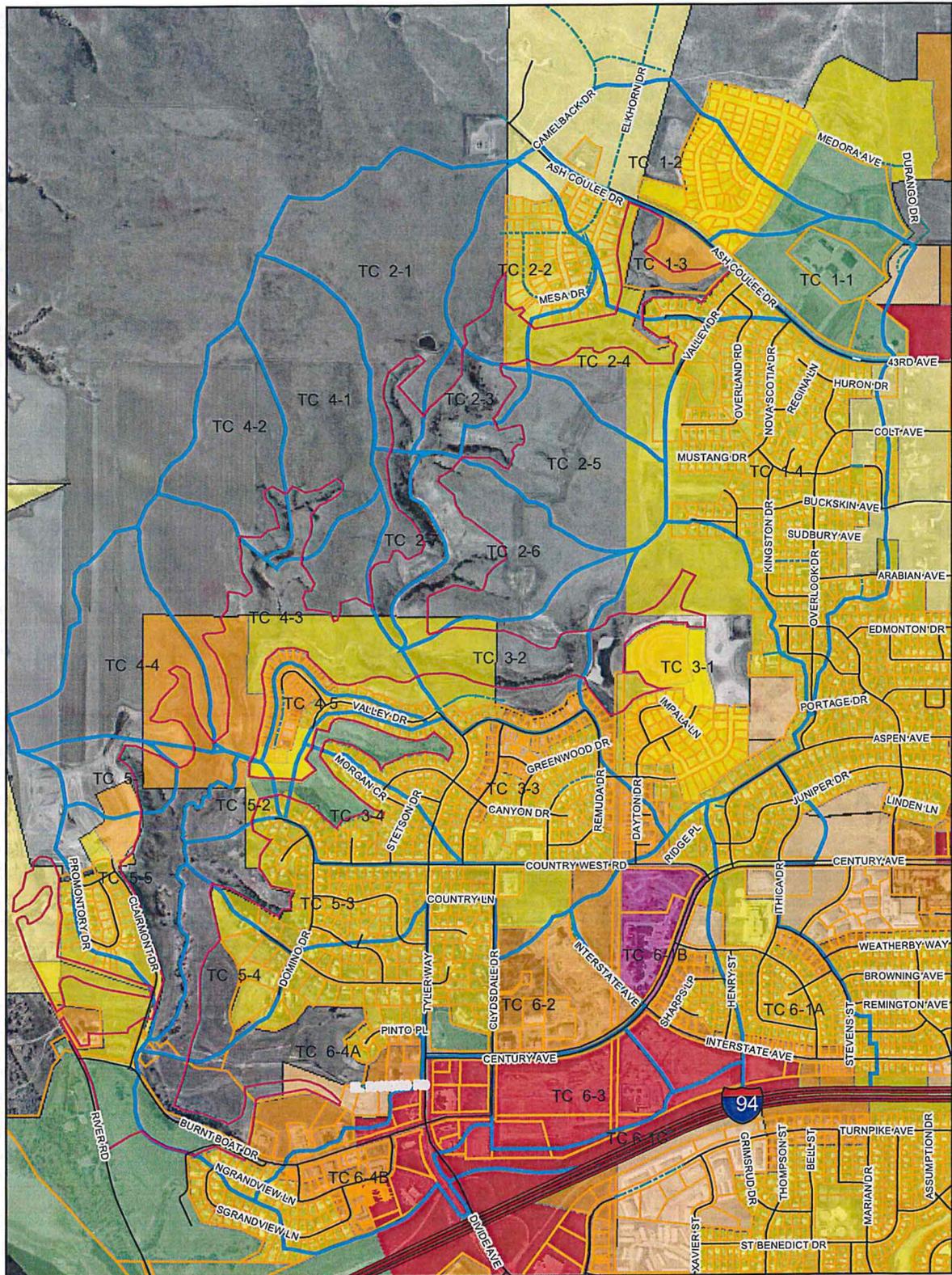
After extensive review it was determined that the level or density of future development had little affect on the size and configuration of the regional storm water facilities. This was primarily related to the dam safety design requirements and sizable D-Soils component within the watershed. The net or percentage increase in runoff on D-Soils associated with development is less than B-soils, therefore, the volume differentials associated with the large runoff events are less pronounced thus the total development mix did not dramatically change the regional peak flows. This relates to the large runoff events for which the regional facilities must be designed. A projection of CN Numbers associated with these soils and R-5 residential development is provided in **Table 3.1.2.1**.

Soil Type	Grassland	Low Density ¾ acre lot	Med Density ½ acre lot	Standard Density ¼ acre lot	RM-10
B-Soils	69	75	78	80	82
D-Soils	80	84	86	87	90

It is important to understand that new urban development still has a profound impact on runoff and will impact the design requirements for local storm water system components. These need to be carefully designed so as not to create or allow adverse impacts. The discussion of local conveyance systems is primarily focused on the receiving streams or tributaries to Tyler Coulee; see **Section 6.0** and **Appendix J**.

The projected master plan land use assumptions are based on the remaining watershed being developed as single-family residential. The primary zoning will be R-5 residential, as the watershed already contains sizable other uses (e.g., school and commercial). The next largest land use component is green space, which is principally comprised of floodplain/breach zones, future park lands, and otherwise undevelopable properties containing steep slopes, and tributary stream conveyance. These land uses have all been included and addressed under what is defined as the Development Control Line (DCL), which is discussed in **Section 4.9** and **Appendix G**.





Legend

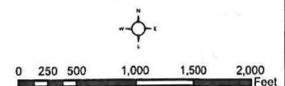
- Development Control Lines
- Subwatersheds
- Parcels
- Road Type**
- Interstate
- State Highway
- US Highway
- City Street

Zone

- | | | |
|---|---|--|
| A | MA | R5-2015 |
| CA | MB | R5-2025 |
| CB | P | RM |
| CG | PUD | RMH |
| CR | R10 | RR |
| HM | R5-2005 | RT |

FIGURE 3.1.2.1
2005 LAND USE ZONING MAP

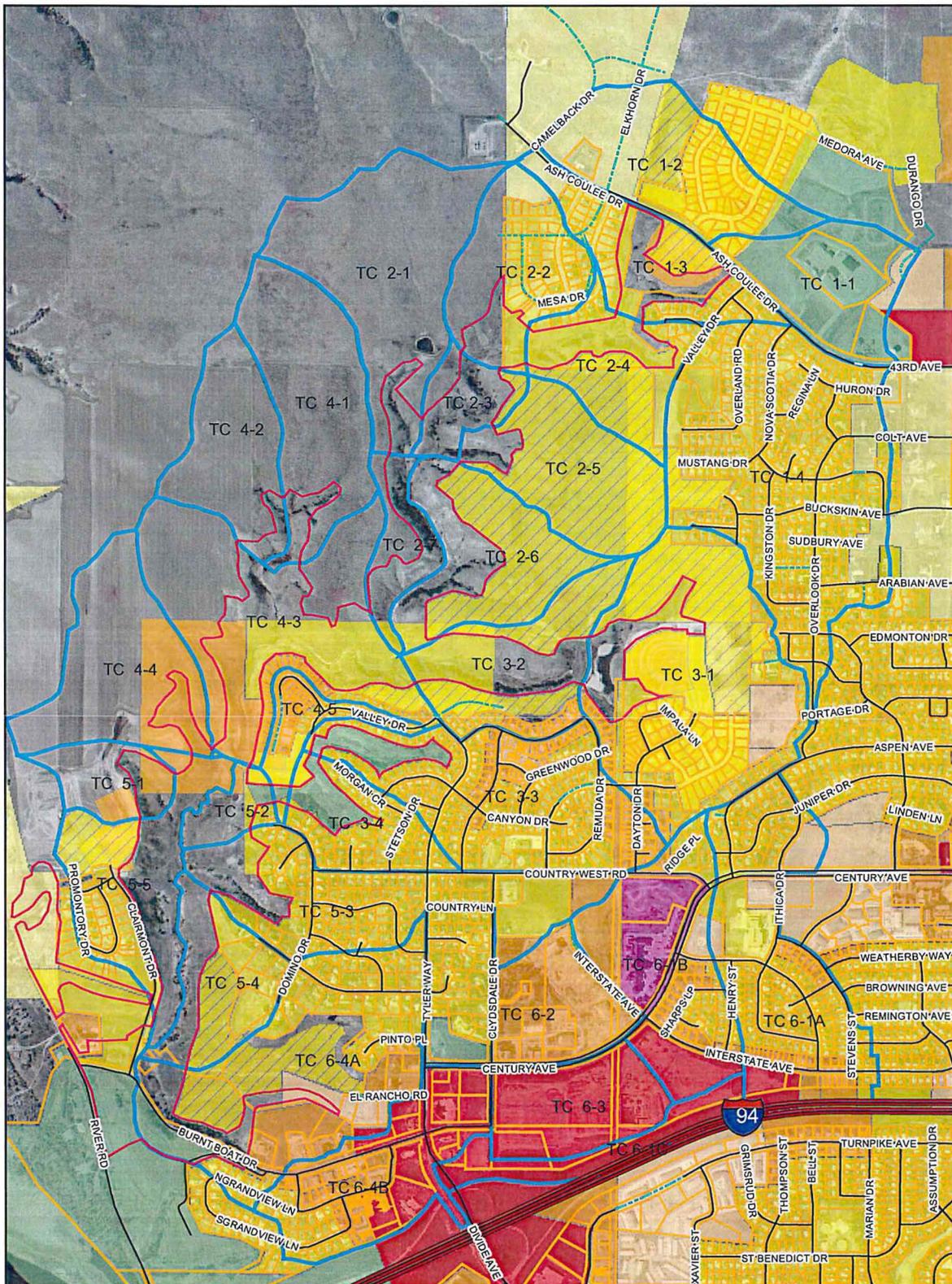
Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota



2005 ZONING AREAS					
Scale: AS SHOWN	Drawn by: MRS	Checked by: MHG	Project No.: 4489-000	Date: 3-28-06	Sheet: 1

Orthophoto Source: City of Bismarck
Date of Photography: April 25, 2001
Data Source: City of Bismarck & ND GIS Hub

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FAX: (701) 333-0300



Legend

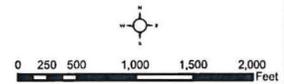
- Development Control Lines
- Subwatersheds
- Parcels
- Road Type**
- Interstate
- State Highway
- US Highway
- City Street

Zone

- | | | |
|---|---|--|
| A | MA | R5-2015 |
| CA | MB | R5-2025 |
| CB | P | RM |
| CG | PUD | RMH |
| CR | R10 | RR |
| HM | R5-2005 | RT |

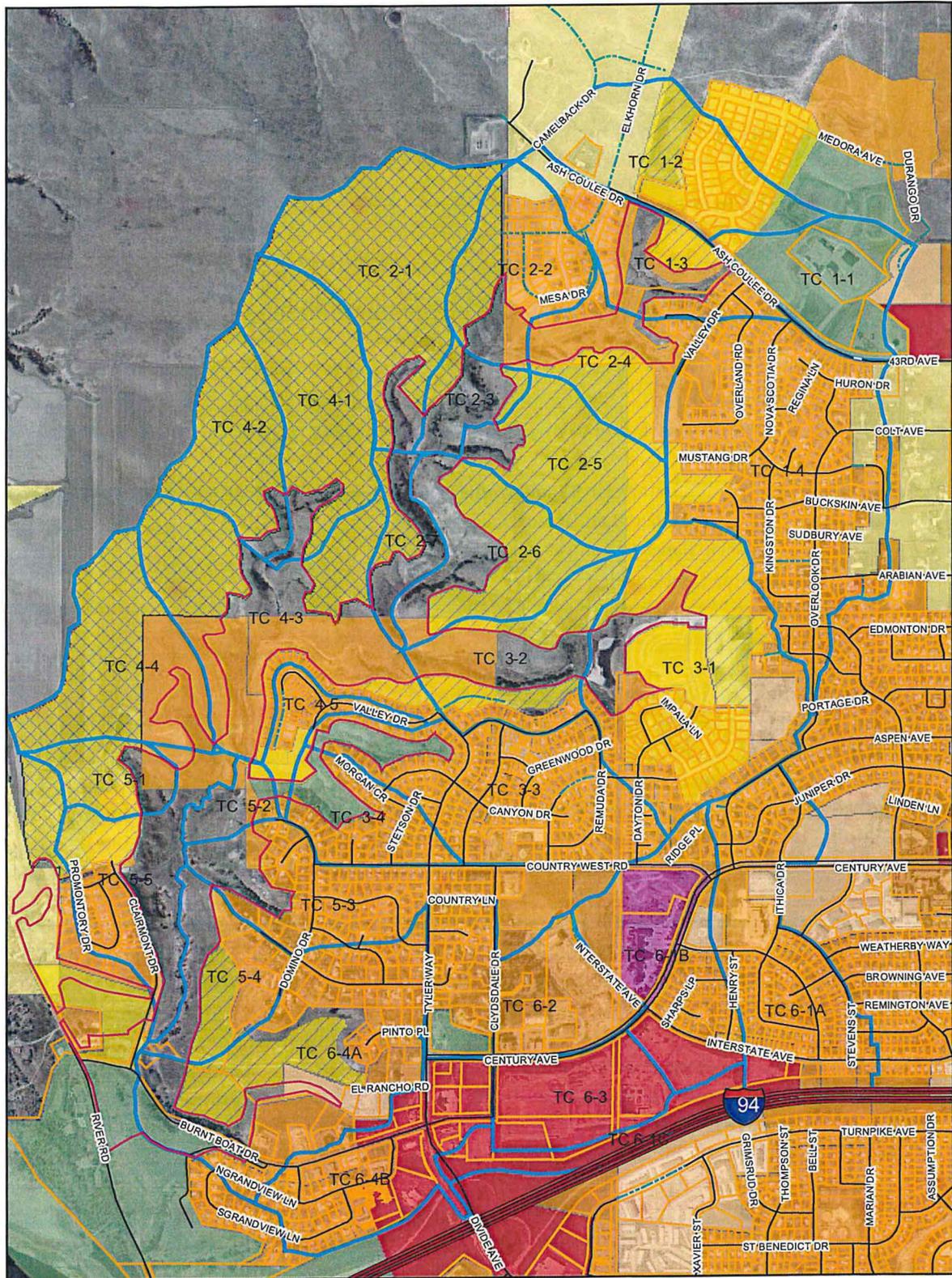
**FIGURE 3.1.2.2
2015 LAND USE ZONING MAP**

**Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota**



2015 ZONING AREAS					
Scale: AS SHOWN	Drawn by: MRS	Checked by: MHG	Project No.: 4489-000	Date: 3-28-06	Sheet: 1
			Houston Engineering, Inc. 3715 LOCKPORT STREET BISMARCK, NORTH DAKOTA 58503 TEL: (701) 323-0000 FAX: (701) 323-0300		

Orthophoto Source: City of Bismarck
Date of Photography: April 25, 2001
Data Source: City of Bismarck & ND GIS Hub



Legend

- Development Control Lines
- Subwatersheds
- Parcels
- Road Type**
- Interstate
- State Highway
- US Highway
- City Street

Zone

- | | | |
|---|---|--|
| A | MA | R5-2015 |
| CA | MB | R5-2025 |
| CB | P | RM |
| CG | PUD | RMH |
| CR | R10 | RR |
| HM | R5-2005 | RT |

**FIGURE 3.1.2.3
2025 LAND USE ZONING MAP**

Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota



0 262.5 525 1,050 1,575 2,100 Feet

2025 ZONING AREAS					
Scale:	AS SHOWN	Drawn by:	MRS	Checked by:	MIG
Project No.:	4489-000	Date:	3-29-06	Sheet:	1
Houston Engineering, Inc.					
3712 LOCUST STREET BISMARCK, NORTH DAKOTA 58503			TEL: (701) 253-2800 FAX: (701) 253-9300		

Orthophoto Source: City of Bismarck
Date of Photography: April 25, 2001
Data Source: City of Bismarck & ND GIS Hub

Table 3.1.2.2 was presented to both citizen work groups and represents an approximation of the distribution between existing and future land uses.

Table 3.1.2.2			
Tyler Coulee Land Use Distribution			
Generalized Watershed Development Summary			
Total Drainage Area	1,905	acres	
Developed Area (platted)	991	acres	52%
Undeveloped Area	914	acres	48%
Less Development Control Line (est.)	318	acres	17%
Green Space Future Park Land (trails etc...) Floodplain/Breach Zone Steep Slopes (3:1 @ 149 acres)			
Remaining Developable Properties (est.)	596	acres	31%
Current Platted Lots	~1,250		
Potential Future Lots @ 2.2/acre	~1,311		

The development of Best Management Practices (BMP's) for use in the watershed was limited by the extended public meetings and focus on dam safety compliance. Subsequently, the implementation of specific BMP's is relegated to the local system design and development components. As such **Appendix J** contains illustrations of various system types presented during the public meetings that might be used by future development. The City has not made any determination or directive related to the use of specific BMP's; therefore, no recommendations are included in this report.

Considering the forecasted land uses and hydrologic modeling assume a predominance of single family and duplex residential it is recommended that all higher density developments be required to incorporate on-site detention to reduce peak discharges. The focus for these local storm water systems should be to achieve a level of control whereas the developed discharges are roughly equivalent to existing discharges. The City will need to determine where this is practical or when variances are reasonably acceptable. While typically measures are not taken to limit runoff volume, any action to reduce the density or imperviousness of future development will impact peak flows, as well as the design configuration and cost for local systems.

Prior community master planning efforts have focused on controlling large runoff events however, it is also important to consider other factors. Therefore, all developments should be required to work toward system designs that mimic current peak flows across all event frequencies. The acceptance of compliance with this objective should not be tied solely to economic considerations, but all factors associated with development impacts.



3.2 Valley Drive and Morgan Court Storm Water Facilities

So as not to stall on-going development during the master planning process it was necessary to evaluate several storm water systems prior to considering other alternatives. These systems included the Valley Drive embankment and proposed Morgan Court Storm Water Facilities. The results of this evaluation as well as recommendations related to the master plan alternatives are contained in **Appendix D**. The following sections outline several elements related to an early review of these facilities, while additional information is presented in **Section 4.0**.

3.2.1 Valley Drive and Tyler Parkway Embankments

Through the evaluation process it was determined that the heart or critical elements in any preferred alternative are the Valley Drive and Tyler Parkway embankments. As such a modified Valley Drive Embankment and the proposed Tyler Coulee roadway crossing at Tyler Parkway represent the primary hydrological control features for this watershed. The analyses indicated these facilities working to complement each other provided a reasonable and acceptable level of flow control within the framework of the NDSE's dam design standards. Each embankment serves a specific purpose in controlling flows as discussed in **Section 4.4** and **Section 4.5**.

3.2.2 Morgan Court Facilities

The Morgan Court Detention Facilities were first incorporated into the Tyler Coulee master planning process in the 2002 Report. Subsequently, a preliminary design was completed as part of this master planning process, which was followed by final design and construction by the developer under a city special assessment district. These storm water facilities are currently functioning and providing the desired benefits.

3.3 Jurisdictional Determinations – Dam Safety

The City and MPWG reviewed a number of alternative facility configurations while developing a preferred alternative. In the end it was determined in order to accommodate intermediate development conditions as well as full development that construction of the Tyler Parkway and Valley Drive Embankment in combination provided the most economical alternative. Information related to the dam classification and jurisdictional issues are provided in **Appendix E**.

Given the high hazard classification of these two embankments a 0.5PMP hydrological analysis was completed utilizing the Preferred Alternative configuration. This event is equivalent to 10.5 inches of rainfall occurring in a 6 hour period. A second 0.5PMP analysis incorporated a breaching of the upstream regional detention facilities with the Tyler Parkway and Valley Drive embankments being configured to contain the resulting inflows without overtopping. A similar design methodology was utilized in the Jackman Coulee Watershed to justify a lower design standard for smaller jurisdictional facilities located upstream.



A breach analysis for the Tyler Parkway and Valley Drive embankments was also completed using a HEC-RAS water surface profile model. The resulting projected maximum flood flows from these analyses were then used to establish a designated flood hazard area along Tyler Coulee. The mapping for this breach zone is illustrated on **Figure 3.3**. This breach zone will be regulated via the creation of a two tier Development Control Line (DCL), which is discussed in **Section 4.9**.

3.4 Corps of Engineering – Permitting

A Corps of Engineers (COE) permit is also required for the construction of the stream crossings within this watershed. While the COE permitting process will require an environmental review this is not anticipated to create a scenario whereby construction could not occur. As a point of interest the MPWG has recommended that no standing water be allowed upstream from these embankments. While this does not preclude future implementation of permanent pools for aesthetics, water quality improvements, sediment collection or flow control this component is not included in the master plan. Subsequently, at this point any mitigation values associated with upstream areas is limited. It is not known if the impacts associated with these facilities will require a formal mitigation process.

3.5 Private Storm Water Management Reports

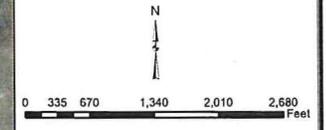
Prior to and during the master planning process a number of storm water management plans and reports were completed in accordance with the City's ordinance. The following reports were reviewed, evaluated and their related storm water management facilities incorporated, where applicable, into the Tyler Coulee SWMM hydrologic model.

- K&L First and Second Addition SWMP
- Horizon Heights First Addition SWMP
- Northwest Middle School, Ash Coulee Dr. SWMP (Horizon Mid School)
- Eagle Crest Subdivision SWMP
- Overland Road Detention Facility Design – City of Bismarck
- Valley Drive East Detention Facility Design – City of Bismarck
- Pinehurst Square Addition SWMP (Lowe's and Kohl's)

Since not all of these SWMP's utilized the same hydrological analysis methodology the design data had to be independently input and integrated into the master plan hydrology model. In doing so the results obtained by via the SWMM analysis did not always calibrate with the other report models. This was deemed not to be a critical element given the focus on the preliminary design of the regional facilities.



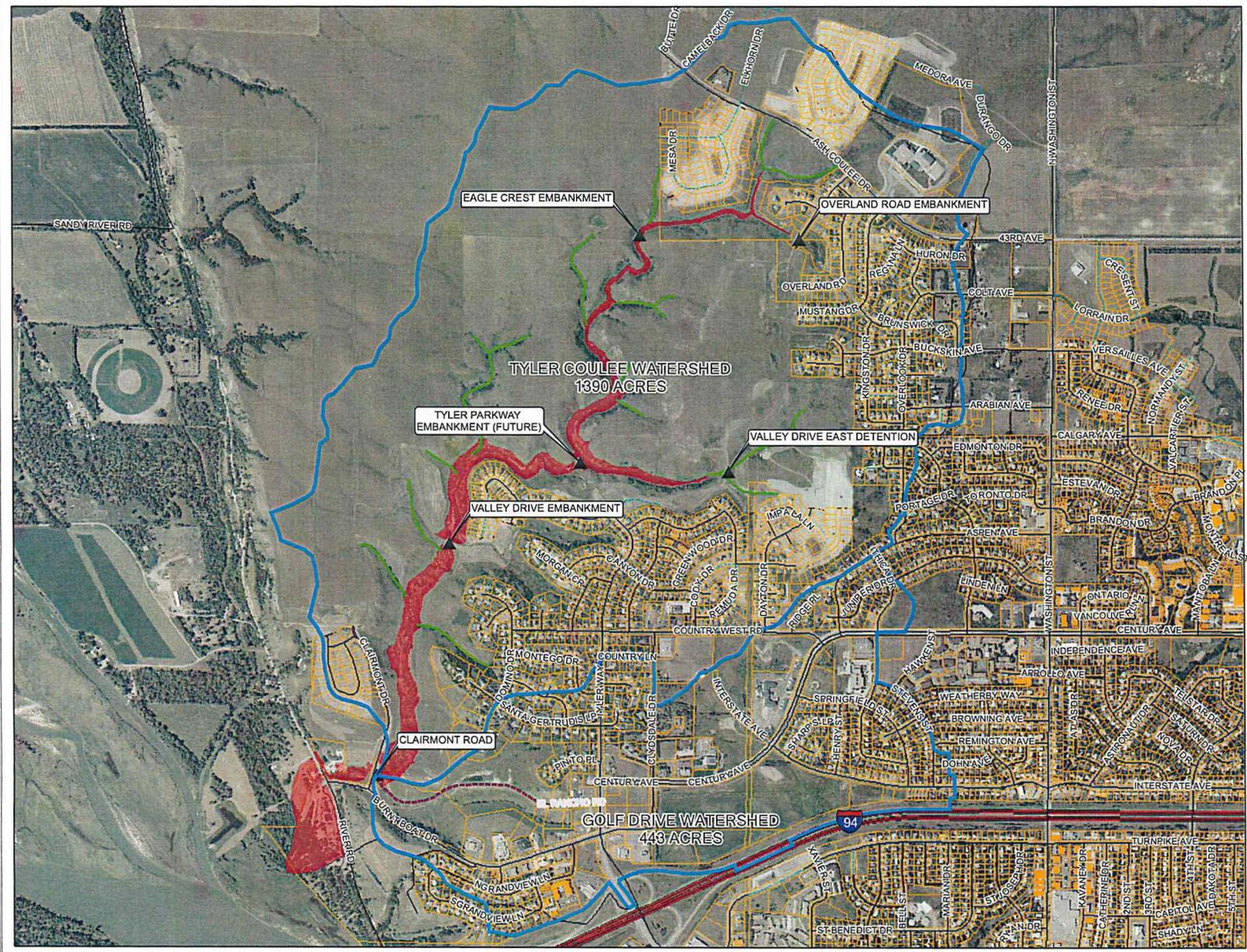
**Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota**



Legend

- Watersheds
- Parcels
- Existing or Proposed Local Detention
- Flood Plain/Breach Zone
- Interstate
- State Highway
- US Highway
- Tributary/Stream Protection
- Golf Drive Drainage Corridor
- Stormwater Management Facilities

**FIGURE 3.3
FLOOD PLAIN/BREACH MAP**



Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & ND GIS Hub

TYLER COULEE & GOLF DRIVE WATERSHEDS

Scale: AS SHOWN	Drawn by: MRS	Checked by: MHG	Project No: 4489-000	Date: 3-28-06
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Houston Engineering, Inc.
3112 LOOPPORT STREET
BISMARCK, NORTH DAKOTA 58503
TEL: (701) 323-0200
FAX: (701) 323-0300

3.6 Regional and Local Facility Definitions

The City after considering input and comments from the citizen work groups developed revised definitions for local and regional storm water facilities. While the reasoning behind these was principally related to responsibility for construction costs it also clarifies a general demarcation for the planning process. Whereas the City is generally involved in the design and implementation of larger regional facilities, the developer or private interests are required to develop and construct local facilities. The following sections present the refined definitions for each. Understanding that there will always remain some overlapping components and costs the City as a matter of policy will review each project independently to determine its status.

3.6.1 Local Storm Water Facilities

Local storm water facilities are those that convey runoff generated by properties directly contributing to the storm water infrastructure. These facilities typically serve one or more subdivision developments and/or undeveloped areas and are lateral conveyance to the main trunk line facilities. The benefits provided are primarily located upstream and/or along the storm water conveyance system. The downstream conveyance facilities at the point of discharge are either natural and/or modified to provide adequate capacity to convey the projected discharges at the time of installation.

3.6.2 Regional Storm Water Facilities

Regional storm water facilities are those that convey runoff generated by properties directly or indirectly contributing to the storm water infrastructure. These facilities typically serve multiple subdivisions, lateral or local storm water system inflows and/or inflows from undeveloped areas. Regional facilities are defined by the City through their watershed master planning process as main trunk line facilities. Master planned facilities are defined by size and scope or simply located along designated corridors. Benefiting areas, or those properties within a future assessment district, include local system watersheds, properties located along the main trunk line conveyance system, undeveloped properties within the watershed and downstream properties. The potential benefits provided by regional facilities beyond conveyance include flood damage reduction, reduced downstream infrastructure costs, aesthetic and recreational values, environmental protection, water quality improvements and green space.

Examples of regional facilities are those included in the Preferred Alternative as described in **Section 4.0**. These will be evaluated, designed and constructed by the City. The repayment for construction will be shared via a special assessment district and City funding, see **Section 5.0**.



4.0 MASTER PLAN FACILITIES – THE PREFERRED ALTERNATIVE

Based on the hydrologic and hydraulic analyses, NDSE dam design standards, and input obtained from public informational meeting and citizen work groups the recommended components of the Preferred Alternative include the following regional facilities:

- Overland Road Storm Water Detention Facility - Existing
- Eagle Crest Detention Facility – New
- Valley Drive East Storm Water Detention Facility– Modified
- Tyler Parkway Embankment – New
- Morgan Court Stormwater Facilities - Existing
- Valley Drive Embankment – Modified
- Clairmont Road – Existing
- Lowe’s and Kohl’s/Golf Drive Corridor – New
- Pioneer Park Drainage Channel - Existing
- Development Control Line – Policy Component

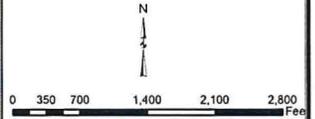
The following sections organized from upstream to downstream briefly summarize the components and purpose for each storm water facility included in the Preferred Alternative. A more detailed discussion along with the hydrologic/hydraulic data for the larger facilities is presented in **Appendix D**. The location for each of these features is shown on **Figure 4.0**.

4.1 Overland Road Storm Water Detention Facility

The Overland Road Storm Water Detention Facility was constructed in 2000 and is an existing functional regional system. It was constructed to control runoff from the fully developed 140-acre Watershed TC1-4. It is anticipated only limited modifications will be made to this embankment as the proposed street section is extended south. As presently configured this facility is considered jurisdictional under NDCC 61-16.2-38. As such any material modifications to this facility could trigger jurisdictional action to bring it into compliance with the NDSE’s design standards. Given the roadway’s design, however, it is recommended the City pursue a reduced hazard classification determination pursuant to the documentation contained in **Appendix E**, and results from both the SWWM hydrology model and HEC-RAS dam breach hydraulic model. The projected costs to modify this facility to comply with the dam design standards are included in the Preferred Alternative. A significant savings, however, would be realized if the existing structure is deemed adequate in its present operational condition.



**Tyler Coulee Watershed
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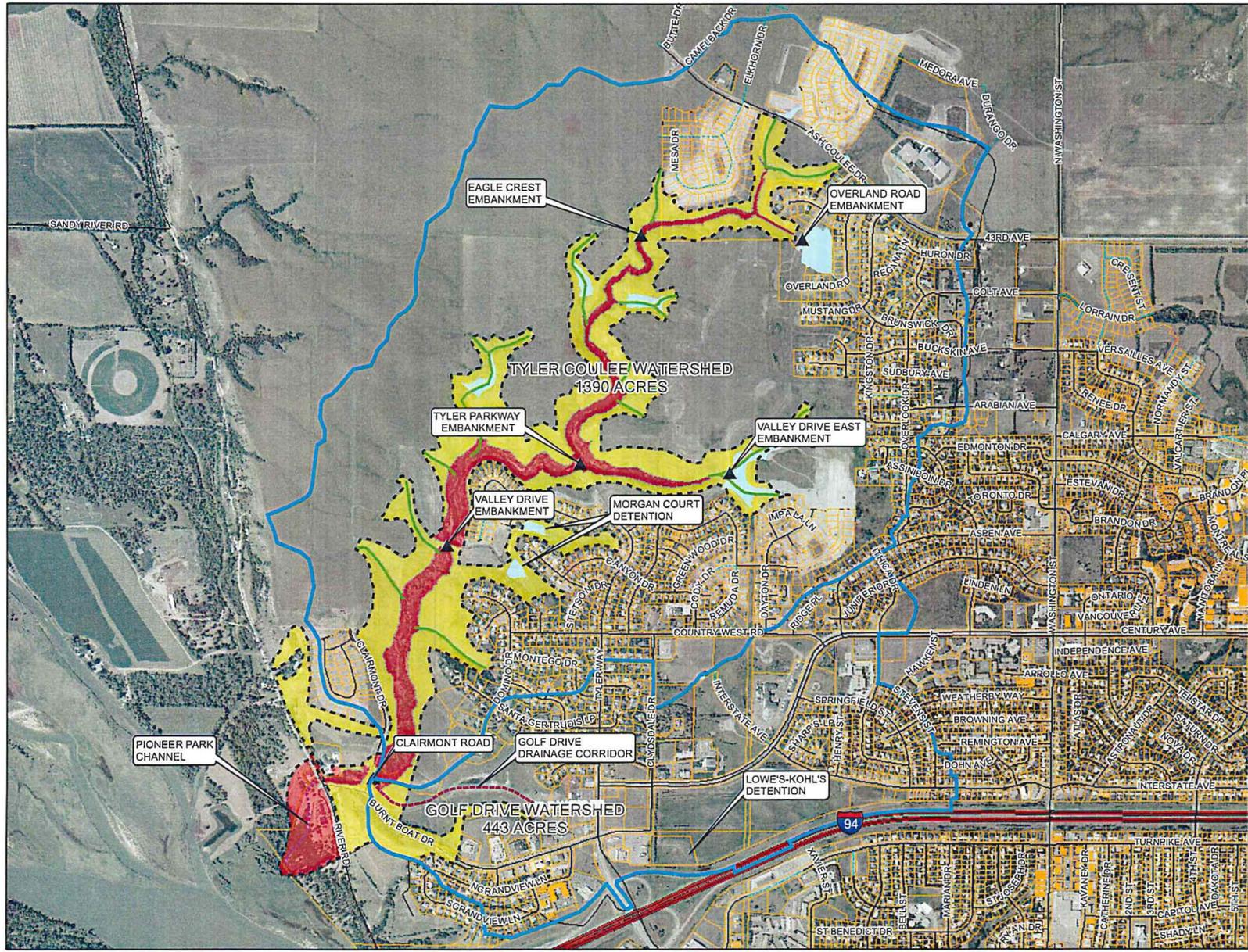
Legend

- Watersheds
- Parcels
- Flood Plain/Breach Zone (Tier One)
- Breach to DCL (Tier Two)
- Developmental Control Line
- Existing or Proposed Local Detention
- Interstate
- State Highway
- US Highway
- Tributary/Stream Protection
- Golf Drive Drainage Corridor
- Stormwater Management Facilities

**FIGURE 4.0
PREFERRED ALTERNATIVE FEATURES**

Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & ND GIS Hub

TYLER COULEE & GOLF DRIVE WATERSHEDS				
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		TEL: (701) 233-0200 FAX: (701) 233-0300		



4.2 Eagle Crest Embankment

The Eagle Crest Detention area will be a new storm water detention facility. Its purpose is to control flows within the main channel along and within the upper reaches of Tyler Coulee. The recently completed Eagle Crest Addition was designed without any control measures to reduce and/or limit flows generated by this development, which significantly increases the risk for damage to the receiving tributary and main stream channel. Controlling the high frequency stream flows and creating back waters is important in stream channel preservation. This facility will also provide flow control on larger events and addresses regional storage requirements for other adjacent upstream development. This does not preclude reducing discharges as well as addressing a means to convey runoff from the upper elevations to the channel section as discussed in **Section 6.0**.

4.3 Valley Drive East Storm Water Detention Facility

The Valley Drive East Embankment is an existing structure constructed in 2000 as part of a sanitary sewer and water line installation to the Horizon Middle School. This embankment was also installed and constructed to accommodate the future extension of Valley Drive to the east and north. While the street section has not been constructed the properties on both sides are being platted for development. This facility currently meets the NDSE/NDDOT stream crossing standards; however, the available detention storage exceeds the 25 acre-foot trigger for a jurisdictional embankment. Therefore, it is recommended that the City request the NDSE to review this location and consider it to be a non-jurisdictional structure as outlined in **Appendix E**.

It is important that the jurisdictional question be resolved prior to any design for the street improvements. The projected costs to modify this facility to comply with the NDSE Dam Design Standards are included in the opinion of probable cost for the Preferred Alternative. A significant cost savings would be realized, however if this structure is deemed adequate in its present operational condition including the future street.

4.3.1 K&L Addition Detention Facilities

The K&L Additions were developed utilizing a storm water management plan that incorporated several smaller detention areas located upstream from the Valley Drive East Embankment. While these are deemed local facilities they have resulted in some challenging decisions for the City related to functionality as well as operation and maintenance. Since these are small non-jurisdictional facilities and have limited impact on the regional system design they were not included in the master plan hydrology. Given the proposed future street improvements over the downstream embankment it is recommended these upstream control measures be remodeled and evaluated to assure compliance with the City street design criteria. The SWMP for these subdivisions only evaluated the flows to their point of discharge, which did not include the Valley Drive East Embankment.

4.4 Tyler Parkway Embankment

The Tyler Parkway Embankment is proposed as a dual purpose facility and is a critical component in the Preferred Alternative. First, this embankment is required to provide a recommended north-south transportation corridor as a minor arterial street. Second, the proposed structure will be designated as a high-hazard facility, and as such is configured to function specifically to control excessive flows associated with the 0.5PMP flood event to comply with the NDSE's standards. The purpose for this design is also to significantly reduce the infrastructure costs at the Valley Drive Embankment. Since a surface flow emergency spillway was deemed impractical, primarily due to topographic constraints, the principal spillway culvert will be designed to convey the entire 0.5PMP discharges without overtopping the embankment.

While it is desirable for large embankments to control the more frequent runoff events the ability to accomplish this objective is limited at this location given the dam safety requirements. The Preferred Alternative, however, includes a 48" RCP low control culvert connected to a secondary riser that conveys the larger inflows into a 6 foot by 6 foot RCP box culvert principal spillway. This configuration optimizes the ability to control the small and large runoff events. As discussed in **Appendix D** there are reasonable reductions on the more frequent events, which are balanced with its ability to contain and control the 0.5PMP event. In addition the Preferred Alternative accommodates consideration of the breach failure of upstream embankments, which may allow consideration of reduced hazard classifications and subsequent design standards.

4.5 Valley Drive Embankment

The Valley Drive Embankment is an existing stream crossing constructed many years ago to provide access across Tyler Coulee. This structure may or may not have required a permit when constructed; however, it currently is designated as a high hazard jurisdictional facility by the NDSE. This embankment presently functions as a significant storm water detention facility and will continue to serve that purpose under the Preferred Alternative configuration. This embankment is scheduled for modification to be utilized as a city street and to incorporate the installation of future municipal facilities, see **Section 4.5.2** and **Appendix F**. The proposed configuration of this facility is outlined in **Appendix D**.

4.5.1 Valley Drive Geotechnical Data

In 1996 as part of a prior storm water management project development a geotechnical study was completed for this embankment. Additional information on this study is presented in **Appendix D** and a separate document noted as *Engineering Report for Country West and Pioneer Park Drainage Improvements, August 1996*. Preliminary indications are that the embankment is suitable for future modification and use as a storm water detention facility as outlined in the Preferred Alternative.



4.5.2 Valley Drive Municipal Facilities Installations

Development pressures associated with the existing status and future use of the Valley Drive Embankment have already come to the forefront for consideration. Platting is currently proceeding on what is known as the Promontory Point Fourth Addition, with development anticipated in 2007. This development is located to west of Tyler Coulee and close to the Valley Drive Embankment. Several factors related to this embankment have now become time critical issues for the City to address. First, is to pursue installing water supply and sanitary sewer services through and/or around the embankment. Since installing these facilities in the embankment will trigger the NDSE's jurisdictional requirements it is clear action is required if these facilities are to be installed in a timely manner. Second, it is important to start the permitting procedures and design to construct Valley Drive across Tyler Coulee to limit any unnecessary delays associated with this process. Given the nature of the Valley Drive Embankment and concurrent need for the Tyler Parkway Embankment the regulatory process currently represents the critical path prior to construction.

A separate technical memorandum related to alternative routings for the municipal service installations was prepared to document the ramifications with each alignment. Subsequently, it was recommended these facilities not be located within the embankment, but routed downstream and around the future expansion limits, to the extent practical, as outlined in **Appendix F**. The alignment and jurisdictional questions need to be submitted to the NDSE for consideration, along with the master plan recommendations to ensure unnecessary permitting requirements are not created.

4.5.3 Valley Drive and Tyler Parkway

The Tyler Parkway Embankment is noted as having a significant value in reducing the costs associated with the Valley Drive Embankment. The Valley Drive Embankment under full watershed development, without the Tyler Parkway Embankment in place would require an emergency spillway containing 3-20 ft by 8 ft RCP box culverts in order to meet the NDSE's design standards. Under the Preferred Alternative this spillway is reduced to 3-10 ft by 8 ft RCP box culverts.

4.5.4 Morgan Court Storm Water Facilities

The Morgan Court Storm Water Facilities were constructed in accordance with the 2002 Report recommendation and the design analysis completed as part of this master planning process. The hydrological analysis and noted benefits from this system are described in **Appendix D**. As part of the Preferred Alternative the storm sewer discharges from this system will need to be integrated into the design of the Valley Drive Embankment. Since this project has been completed there are no specific costs included in the Preferred Alternative. The anticipated costs to integrate the storm sewer system are included in the contingencies for modifications to the Valley Drive Embankment.



4.6 Clairmont Road

Clairmont Road is an existing city street designed and intended as a watershed control feature located at the bottom of the watershed. Since this street is not scheduled for any modifications jurisdictional issues are not anticipated. This structure is in compliance with its original design with a slight reduction occurring in peak inflows under a fully developed watershed compared to existing conditions. Subsequently, the projected flows downstream into Pioneer Park are also less than those under existing conditions.

4.7 Pinehurst Square – Golf Drive Corridor

A storm water management analysis of the hydrology and storm sewer system hydraulics for the Pinehurst Square Addition retail development and existing City streets, while outside the original scope of services was incorporated considering its impact on the larger regional storm water conveyance systems including the Golf Drive Corridor. This analysis included an assessment of the proposed storm water detention facilities installed as part of the retail development and the existing storm sewer systems under Century Avenue and the Burnt Boat Road/Tyler Parkway intersection.

The SWWM system analysis indicated that while the storm sewer in the intersection suffers from design deficiencies, the detention system within the commercial area has a measurable value and benefit in reducing peak flows into the Golf Drive Corridor. The problems with intersection flooding, however, are independent from corridor inflows and as such are not addressed in this master plan. The current conveyance system within the Golf Drive corridor is a surface water channel that suffers from significant and recurrent damages due to extended duration low flows and excessive high flows. Under the Preferred Alternative these flows could be conveyed in a 48" RCP storm sewer and high water overflow channel as discussed in **Appendix G**.

4.8 Pioneer Park Channel

The Pioneer Park Channel was designed to accommodate somewhere between a 2-year and 5-year 6-hour runoff event. The Preferred Alternative will not materially increase the peak flows at this location, which was a concern voiced by the BPRD. The Preferred Alternative also does not include or recommend any additional modifications to the Pioneer Park Channel. It should be understood, however, that the capacity of the channel system is limited and as such periodic flooding will continue to occur during large runoff events. The recent construction of the Pinehurst Square Detention Facility as well as the planned modifications to Valley Drive and Tyler Parkway Embankment construction will result in the primary regional benefits to protect Pioneer Park as proposed under the Preferred Alternative.



4.9 Development Control Line

While reviewing the storm water master plan alternatives it was documented that many areas along Tyler Coulee, including the adjoining steep slopes, presented significant issues related to future land uses and development. Subsequently, a policy associated with these areas was developed and is recommended for implementation to address these areas. As such the City is anticipated to formally accept and/or adopt the Development Control Line (DCL) illustrated on **Figure 4.9**. The following is the policy statement developed as part of the citizen work group process.

A two tiered management or policy approach is recommended to control development along Tyler Coulee, within its tributaries and throughout its steep slope bluff line.

Tier One That area to be strictly reserved for maintaining and managing storm water conveyance including natural and/or man-made channels, designated floodways or dam breach zones, and designated access.

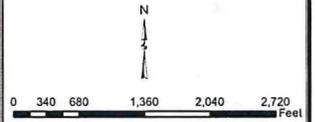
- Allowable encroachment into Tier One is limited to following:
 - Collector or arterial roadways
 - Conveyance and/or traffic capacity modifications to existing roadways
 - Public Utilities and Infrastructure
 - Storm Water detention/retention and conveyance facilities

Tier Two Those areas located along any watercourse or within the watershed that are identified as not being in the best interest of the public to be developed. These areas are typically defined as those located within storm water conveyance areas, floodplains or having steep slopes (or other environmentally sensitive conditions), which require significant fill and/or grading to make them viable for development.

- Concerns with development or encroachment within these areas includes, but is not limited to, the following:
 - The placement of fill material within a floodplain, watercourse or low lying area typically results in a reduction of storm water conveyance capacity and/or flood storage. If allowed to occur via an approved storm water management plan and/or permit this reduction must be offset by the developer. This acceptability of the proposed offset to be determined by the City Engineer.



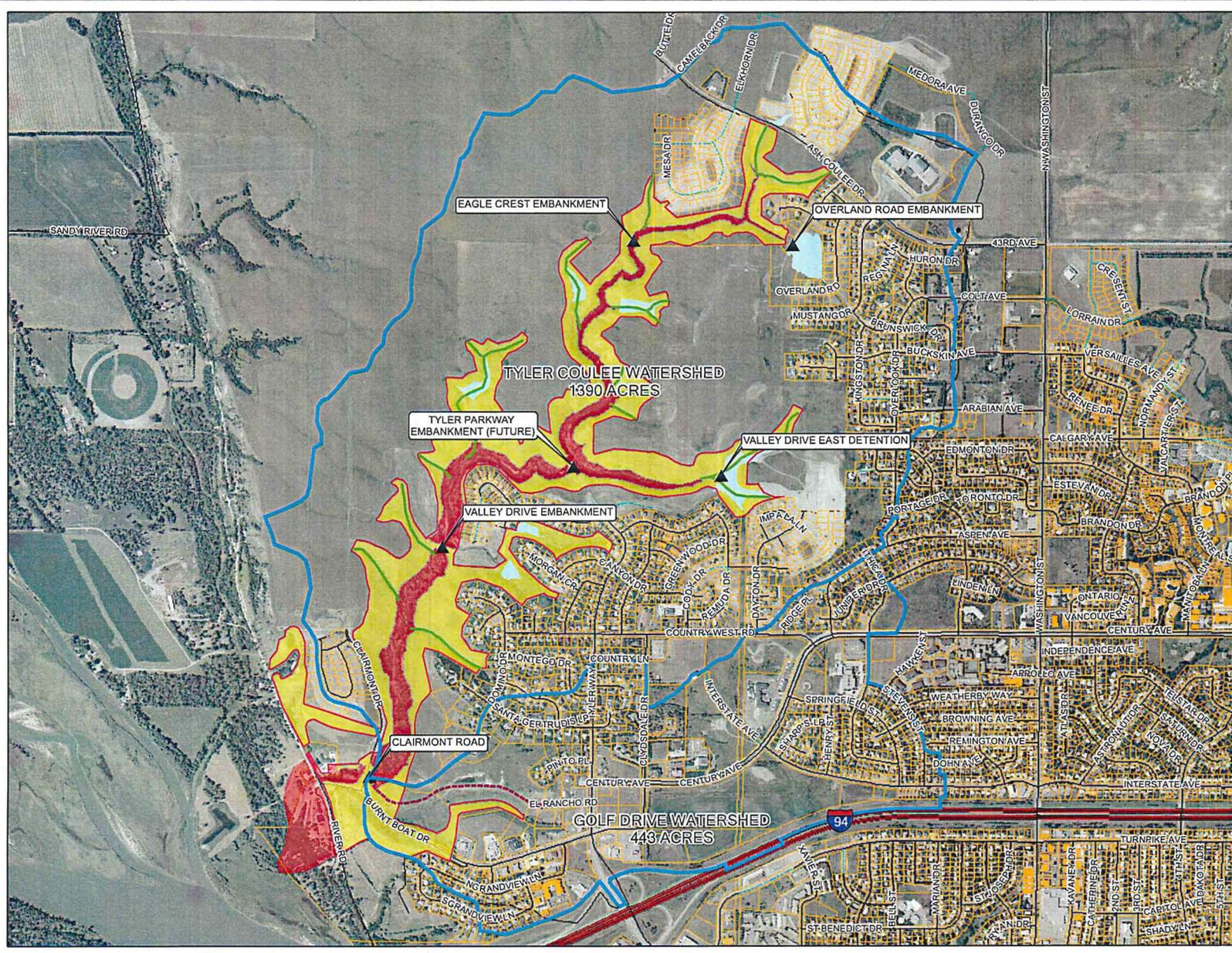
**Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota**



Legend

- Watersheds
- Parcels
- Flood Plain/Breach Zone (Tier One)
- Breach to DCL (Tier Two)
- Existing or Proposed Local Detention
- Interstate
- State Highway
- US Highway
- Tributary/Stream Protection
- Golf Drive Drainage Corridor
- Stormwater Management Facilities

**FIGURE 4.9
DEVELOPMENT CONTROL LINE**



Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & ND GIS Hub

TYLER COULEE & GOLF DRIVE WATERSHEDS				
Scale	Drawn by	Checked by	Project No.	Date
AS SHOWN	MFS	MFG	4489-000	3-28-05

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3112 LODGPOFF STREET
BISMARCK, NORTH DAKOTA 58503
TEL: (701) 333-0200
FAX: (701) 333-0200

- The placement of excessive fill material can create issues and concerns related to slope stability and settlement. Geotechnical reports certifying the ability to construct stable and maintainable slopes along a watercourse should be provided to the City as part of the storm water management plan or permit process and accepted for the project record prior to completing site grading.
- Steep slopes are generally difficult to re-establish vegetation on. Therefore, erosion is a concern for both the stability of the slope as well as deposition of sediments in the downstream watercourses and onto undevelopable properties or environmentally sensitive areas.
- These and related issues will be reviewed and considered via storm water permits submitted for development.

The City may allow encroachment within Tier Two if:

- The impact area is considered minor and will not adversely impact storm water conveyance, flood storage, (e.g., fill within the Tyler Coulee or Missouri River floodplains, or local tributary floodplains) or slope stability.
- The developer mitigates all impacts related to changes in conveyance and/or storage for fill materials placed within the watercourse, floodplain or steep slopes. Mitigation can occur either via on site construction or potentially a financial contribution to other existing and/or yet to be determined facilities. The City will develop a method to account for such losses in conveyance and/or storage if encroachment is to be considered. Any expenses incurred for work within the DCL would be the sole responsibility of the developer.

It is recommended that the DCL be required to be shown on all preliminary plats, in those watersheds where it has been established. This DCL should also be documented on the final plat via an easement or restricted use line. It is anticipated that through the planning process and approval of a formal grading plan associated with the approved storm water management plan that this line may require marginal relocations. Because this DCL requirement applies only to new plats the process for requesting waivers or relocation of the DCL is already in place as public comments on such would occur during the public hearings held before the planning committees and city commission.



It is recommended all future storm water management plans requesting Tier One waivers be presented to the City Commission for approval. All Tier Two waivers would be the City Engineer's responsibility and either denied or authorized as part of the storm water management plan and permit process. It is also recommended that the City's storm water design standards be revised to formally adopt and implement the DCL policy.

4.10 Engineering Opinions of Probable Costs

Table 4.10.1 presents summary of the engineering opinion of probable costs associated with the Preferred Alternative project components, as updated to reflect 2007 prices. An itemized cost breakdown for each facility is provided in **Appendix I**.

Table 4.10.1	
Tyler Coulee/Golf Drive Watersheds	
Opinion of Probable Cost	
Valley Drive Embankment	\$1,607,000
Tyler Parkway Embankment	\$1,401,000
Valley Drive East Embankment	\$143,000
Eagle Crest Embankment	\$673,000
Overland Road Embankment	\$156,000
Golf Drive Watershed (Revised Project)	\$1,172,000
Preferred Alternative Total	\$5,152,000

Table 4.10.2 presents a summary of the project cost distribution between the two watersheds, and those the City's Storm Water Utility Fund will have to finance in abeyance for future development. The City investment will be recovered via future front end developer payments and/or special assessments on undeveloped properties as they are platted and annexed into the City. This distribution is based upon the City's adopted revisions to their storm water utility fund as noted in **Section 5.0**. Based on an alternative analysis it was determined that utilizing the Tyler Parkway Coulee and Valley Drive Embankments in series resulted in a savings of approximately \$720,000. This is roughly equal to one-half the cost to construct that portion of the Tyler Parkway Embankment required for storm water management. The remaining portion of the embankment was deemed attributable to transportation system or street.

Table 4.10.2	
Tyler Coulee Watershed	
Assessment District Cost Distribution	
Tyler Coulee	\$2,084,000
Golf Drive	\$1,059,000
Subtotal	\$3,143,000
City of Bismarck Cost Abeyance [1]	\$2,009,000
Total Regional Project Cost	\$5,152,000
[1] City abeyance costs are based on the remaining projected developable properties within the watershed. Those properties within the DCL are not included as being assessed.	



Table 4.10.3 presents a comparison of the cost distribution per square foot under the old financing methodology and the revised method developed as part of this master plan process. The revised financing methodology allows for a more uniform, equitable and time based distribution of project costs.

Table 4.10.3 Tyler Coulee Watershed Assessment District Cost Distribution		
Watershed	Old Method Cost per sq.ft.	Revised Method Cost per sq. ft.
Tyler Coulee	\$0.213	\$0.1116
Golf Drive	\$0.094	\$0.0847

A pending jurisdictional request to the NDSE may result in the acceptance of the Overland Road and East Valley Drive embankments in their present operational conditions. If this occurs the costs for these two facilities may be avoided; though some modifications related to street improvements will still be required. This would reduce the projected total cost of the Preferred Alternative by approximately \$300,000.

5.0 FINANCIAL CONSIDERATIONS – PROJECT FUNDING REVISIONS

Throughout the citizen work group process the City worked to develop a program to address citizen concerns relative to financing storm water infrastructure. The City focused on methods to not only address the issues within the Tyler Coulee Watershed, but that could be applied to any community project. As part of process via the Financial Work Group (FWG) a number of financing methods were evaluated. **Figure 5.0** is a matrix developed that presents the basic elements associated with each funding alternatives. This matrix was clarified for this report to incorporate additional elements related to the water resource district special assessment process not included in the original matrix.

After extensive discussions, City staff developed a formal recommendation to modify the City’s Storm Water Utility Fund. The following is the unedited and highlighted proposal as presented to and adopted by the Bismarck City Commission on June 14, 2005.

“We (City Staff) are recommending several changes to the City’s current policies for funding storm water improvements. These changes are necessary to allow the City to construct regional storm water facilities in a timely manner as required by federal regulations and to equalize the cost of these projects over the entire benefited area.

1. *Establish a reserve fund in the Storm Water Utility with initial funding from existing cash reserves of \$1,000,000. This fund would be used to finance the portions of projects attributable to currently unannexed areas and would be repaid by Special Assessments applied to these areas as they annex.*



Figure 5.0
STORM WATER FINANCING MATRIX

FINANCING VEHICLE	PLUS	MINUS	MITIGATION STEPS
Water Resource District	<ul style="list-style-type: none"> • May levy specials on properties located outside city limits • May bond for expenses • Ability to levy annual operation and maintenance assessments on all properties. Maximum annual is \$1.50/acre on agricultural land and \$1.50 per \$500 of taxable valuation on other properties. • Ability to annually reassess and redistribute remaining project expenses as watershed continues to develop • Voting and public hearing process allows input and majority of assessment is required for project approval. 	<ul style="list-style-type: none"> • Voting process could be cumbersome given the larger number of properties involved. • Phased development of project may present issues relative to construction timelines • Statutory 20% limitation on cost increases from vote to construction. 	<ul style="list-style-type: none"> • Combine with other options • Evaluate potential Joint Powers agreement with the BCWRD • Review options on assessments to city lots and ability for phased implementation.
Storm Water Utility	<ul style="list-style-type: none"> • Paid by all residents • Simple collection process • Can provide "project development fund" to construct new infrastructure prior to development as well as future maintenance • Possible source for regional project funding 	<ul style="list-style-type: none"> • Not project specific • May not be politically saleable • Hard to match charges to benefits 	<ul style="list-style-type: none"> • Clearly define the intended purpose for the fund and expectations for its use
Special Assessments	<ul style="list-style-type: none"> • Project specific • Bondable • Can use be blended over several projects • Can use formula 	<ul style="list-style-type: none"> • Can't be levied outside City of Bismarck • Additive to property taxes 	<ul style="list-style-type: none"> • Combine with other options • Could be held in abeyance for property outside City if "bank" is available for financing
Impact Fee	<ul style="list-style-type: none"> • Applies to all lots before sale • May be financed with the lot • May be used outside the city limits • Could allow projects to be built when needed • Paid by developer in advance of development 	<ul style="list-style-type: none"> • Can force improvements to be made ahead of need • Can deter development • Purchase price of lot could reflect changes • Greatest impact on the smaller developer • Determination of impact fee may require the completion of watershed master plans and annual adjustments. 	<ul style="list-style-type: none"> • Use a blended approach (50% paid by developer, 50% assessed to lot owner) • Implement on policy basis so everyone knows what to expect and sticks to it
Sales Tax	<ul style="list-style-type: none"> • If funding available, could be project bank 	<ul style="list-style-type: none"> • Other competing interests: bridge and other projects 	<ul style="list-style-type: none"> • Cost analysis and explanation • Funds committed through 2008 • Additional Tax Could be authorized
Grants	<ul style="list-style-type: none"> • Did get FEMA grant for Jackman Coulee • Section 319 Grant Funding Obtained for Hay Creek Corridor Study – Capitol Avenue Outfall 	<ul style="list-style-type: none"> • Grants usually tied to flooding or other natural disasters. • Water quality grants available, however, demand for available funds is high 	<ul style="list-style-type: none"> • A grant could be written if a major flood event occurs • Other potential grants could be considered through other agencies.



2. *Additional funding of this reserve would be provided by the following proposed increases to the monthly Storm Water Utility fee:*

\$1.00/month/residential customer (Current fee is \$1.75)
\$0.20/month/additional living unit over one (Current fee is \$0.35)
\$1.00/month/10,000 sq ft of commercial property (Current fee is \$3.50)

Proposed increase is to be effective July 1, 2005.

3. *Special assessments for regional storm water facilities for commercial/industrial properties would be calculated at a rate of two times the amount for residential property (on a per sq ft basis), to reflect the greater amount of runoff contributed.*
4. *New property would be required to prepay for a portion of the regional storm water improvements at a rate of \$0.005/sq ft for residential and \$0.01/sq ft for commercial property."*

6.0 TYLER COULEE CHANNEL AND TRIBUTARY PROTECTION

A major management issue within the Tyler Coulee Watershed is the need to establish definitive measures to adequately protect those lands located along the storm water conveyance systems. While efforts were undertaken to establish a Development Control Line (DCL), which results in some protection for these sensitive areas, significant issues remain to be resolved. These are principally related to projecting the main Tyler Coulee stream channel, the contributing tributary channels, and the adjacent slopes along which runoff may be concentrated and/or discharged into from new development. The following sections briefly outline these topics and provide a recommended approach to controlling or preventing potential impacts.

6.1 Tyler Coulee Stream Channel

Protective measures for the Tyler Coulee stream channel will take several forms in the final development scheme. The first is the protection provided by installing the various Preferred Alternative storm water detention facilities. These can provide backwater conditions, reducing flow velocities and thus creating limited sediment collection areas within their respective flood pools. The second is a need to provide adequate scour and erosion protection from surface inflows in the tributary channels and discharges from existing and/or new storm sewers. The point of discharge location as well as upstream and downstream areas will require adequate protection to prevent erosion damage. The basic methodologies used to evaluate and design open channel systems is included in Chapter 7 of the City's Storm Water Design Standards Manual, however additional technical information related to soils and channel stability considerations is contained in **Appendix J.**



6.2 Tributary Channels

It has been common historic practice for developers to want to locate storm sewer outfalls at the upper end of a receiving tributary and discharge them without consideration for downstream impacts. This practice is unacceptable as it dramatically increases the risk for head cutting, excessive bed and slope erosion and will result in significant damage to these tributaries. **Appendix J** outlines a design procedure whereby the engineer is provided as a guideline to follow when evaluating and designing for channel stability. While simple approaches such as maximum allowable velocity are adequate for shallow gradient channels they are less applicable to protect steeper tributaries, which in this watershed can range from five (5) to thirty (30) percent. Subsequently, special considerations are necessary to ensure channel stability, and the design engineer via the storm water management plan and permit procedures will need to justify their designs to comply with the objective to protect these channels.

It is anticipated in most instances that these tributary channels will not be capable of conveying the projected flows. In such cases it will be necessary to install a storm sewer down the tributary to a discharge point located at the main stream channel or to provide an alternative means of channel protection. The use of purely structural methods to protect the channels (i.e., concrete liners, rock riprap, grouted rock riprap etc...) is not acceptable. Another option is to split the flows between a storm sewer and surface water channel. The discharge point on the main stream channel will need to be configured to provide adequate energy dissipation capability to eliminate the risk for scour and damage to the receiving channel. In general outfalls should not be placed perpendicular to the receiving channel. Locating the storm sewers in the center of the tributary should also be carefully evaluated as avoiding these naturally established conveyance area has benefits to be considered.

6.3 Tributary Slopes and Concentrated Runoff

The slopes adjoining the tributary conveyance features for Tyler Coulee will be subjected to potentially adverse impacts associated with development. These slopes are often rather steep and as such in many instances have been placed within Tier Two of the DCL, which requires they be given special consideration. Simply allowing uncontrolled runoff from a residential yard or street to flow across these lands is unacceptable. Typically concentrated flows occurring between lots and/or from downspouts or other local runoff control elements will cause erosion damage on the tributary slopes. The recommended approach is to require all roof drainage (i.e., downspouts) from these residences and the yards, to the extent practical, be drained toward the street or away from the slope where runoff can be better accommodated in a structural conveyance system. This can prevent most of the adverse impacts typically associated with concentrated flows on these slopes.

In addition it is anticipated that individuals in an attempt to maximize their usable yard space will install various types of retaining walls that will change the grading on the slopes adjoining the tributaries. As such this activity is known to have created serious problems with erosion, sedimentation and in some instances encroachment on other properties. Measures to address these concerns are presented **Section 6.5**.



6.4 Undevelopable Land Policy

The City adopted Ordinance #5279 which relates to their definition of undevelopable properties. The following is an excerpt from this ordinance and is provided as information related to the impacts within the tributary areas and Tier Two DCL:

“c. All areas proposed for development shall be platted to the edge of the property with all undevelopable land included within the plat (subject to discussion and agreement by the landowner and the City).

1. *Land determined by the owner and City to be undevelopable and/or needed for stormwater purposes shall be:*
 - a. *Included in adjoining platted lot(s) as a stormwater easement that is privately owned, with only major maintenance by City. The amount of property taxes and special assessments for these areas will be determined by the City based on the level of benefit and the value of the land; or*
 - b. *Platted as a separate lot(s) that is owned and maintained by the City, as a regional stormwater conveyance or detention facility; or*
 - c. *Platted as a separate lot(s) that is owned and maintained by the Bismarck Parks and Recreation District (subject to their agreement) as a natural area; or*
 - d. *Platted as a separate lot(s) that is owned and maintained by the Bismarck Parks and Recreation District, (subject to their agreement) and including a City-maintained stormwater easement; or*
 - e. *Any combination of the above options.*

Undevelopable land will be maintained as a natural area unless a drainage easement is present and the easement requires major maintenance. Major maintenance shall include maintenance of existing structures, mowing below floodplain elevation, cleaning of sediment and maintenance of access.”



6.5 Tributary Channel Protection Recommendations

The following recommendations were developed after evaluating the various uses along the Tyler Coulee stream channel, the associated tributary conveyance systems and the adjacent slopes. These recommendations should be given careful consideration and incorporated as applicable into the City's Storm Water Design Standards Manual, which is a policy document, and/or where appropriate the Storm Water Ordinance.

1. Stream velocities greater than three feet per second (3 fps) shall not be allowed in any existing natural grass channels without justification as to channel stability. The ability to allow higher velocities must be supported via a specific computational assessment and documentation. This limitation should apply to all frequency runoff events not just the standard storm sewer system design event (e.g. 5-year residential or 10-year commercial).
2. Velocities greater than three feet per second may be allowable only where the design engineer has provided suitable justification, including but not limited to the potential use of acceptable channel liner systems. The use of purely structural methods to protect the channels (i.e., concrete liners, rock riprap, grouted rock riprap, gabions, etc...) is not acceptable.
3. The maximum constructed slope for earthen cuts or fills adjacent to the tributary channels shall be 3:1. This applies to all lands that are designated as being within the Tier Two boundary of the Development Control Line (Tier Two DCL). All constructed or disturbed slopes outside this boundary shall not be steeper than 4:1.
4. It is recommended that retaining walls, including residential installations, having heights equal to or greater than four feet or any combination thereof exceeding this height should be required to have a geotechnical report and engineering stability analysis completed prior to construction. The purpose is to ensure slope stability and the prevention of impacts to the receiving tributaries or main channel.
5. The placement of any material (e.g. earthen fill, debris, grass, etc...) within the Tier Two DCL should require prior written approval from the City. This may require revisions to the City storm water ordinance and enforcement provisions to insure compliance.
6. All residential lots bordering the Tier Two DCL shall have their yards and roof drainage directed away from the tributary slopes as much as reasonably practical. Only limited downspouts or rain gutter systems should be allowed to discharge onto the adjacent slopes.
7. All rain gutter systems on new residential construction should have temporary extenders placed on them to direct all flows to the street until such a time as the vegetation within the yard has reached a level considered for 70% coverage.



8. All grass seeding on slopes within the Tier Two DCL shall be of a native species similar to those existing within the designated green space. It is recommended that a native seed mixture be developed by the City Engineer for use within the Tyler Coulee Watershed. All disturbed slopes and seeding completed within the Tier Two DCL boundary shall be protected by using a suitable fiber or permanent matting to retain topsoil, moisture and enhance seed germination and growth. Watering is recommended to facilitate and insure the restoration of these areas.
9. All disturbed areas within any development upon which final rough grading has been completed shall be straw mulched or have straw incorporated (e.g. crimped) into the soil structure to reduce the risk of erosion from water and/or wind. This shall be required prior to topsoil placement as this typically does not occur until residential construction has been completed.
10. In rolling topography, such as that within the Tyler Coulee Watershed and its tributaries, it is common for developers to utilize methods to expand their useable building area by implementing grading that requires substantial earthmoving activities (i.e., cuts and fills). This process can create issues associated with significant filling of the natural tributaries, many of these which could be within the Tier Two DCL. As such the stability of the resulting slopes in these areas creates concerns for impacts to the adjoining tributaries. It is recommended the City consider a process to ensure adequate geotechnical evaluations are completed for these areas.

7.0 CONCLUSIONS AND RECOMMENDATIONS

After reviewing the various components of this master plan report and its appendices it is noted that numerous recommendations are contained therein. Subsequently, to repeat them here is repetitive, however the primary recommended action items before the City related to the Tyler Coulee Storm Water Master Plan are as follows:

1. Submit to the North Dakota State Engineer a request to formalize the jurisdiction determinations for the various regional storage facilities.
2. Pursue the phased implementation of the Preferred Alternative storm water facilities for the Tyler Coulee Watershed as outlined in this master plan report.
3. Adopt and implement the recommended Development Control Line and the associated policy and ordinance revisions governing the use of and/or impacts to lands within these designated areas. This includes the restrictions on development within the Tier One (Floodplain/Breach zone), Tier Two (steep slope, sensitive areas and undevelopable properties) and the tributary protection requirements and measures outlined in **Section 6.5** (e.g., grading slopes, erosion control, geotechnical requirements, etc...).



4. Accept the final report and continue to monitor development and impacts in accordance with the recommendations contained within this master plan report and its appendices.
5. The City has already taken action to adopt a revision to their storm water utility to address the financing questions associated with the recommendations of the Citizen Work Groups. This is recognized as a positive step toward future storm water facility development and construction throughout the community.
6. It is recommended the City update this master plan and the SWMM hydrologic models as necessary to evaluate specific developments as they are submitted.
7. Considering the forecasted land uses and hydrologic modeling assume a predominance of single family and duplex residential zoning it is recommended that all higher density developments be required to incorporate on-site detention to reduce peak discharges. The focus for these local facilities should be to achieve a level of control whereby the developed discharges are roughly equivalent to existing discharges. The City will need to determine where this is practical or when variances are reasonably acceptable.

