Tyler Coulee
Storm Water Master Plan

Presented to:
City of Bismarck, ND

Presented By:
Houston Engineering, Inc.
Bismarck, ND

February, 2007

Bismarck

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
Ken Royse, Chairman
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221 North 5th Street
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
- Mark Bohrer
- Fay Connell
- Gene Duchsherer
- Brian Eiseman
- Bob Entringer
- Robert Fischer
- Kyle Forster
- Al Frank
- Carolyn Frank
- Lowell Fruhwirth
- Gilberto Gonzalez
- Mark Gonzalez
- Kent Hauge
- Rodney Hoff
- Kevin Holm
- Scott Hopfauf
- Bill Huether
- Don Jensen
- George Keiser
- Fred Kraft
- Les Larson
- Paul Maddock
- Harvey Melstad
- Kelly Moldenhauer
- Ed Murphy
- Larry Nieters
- Scott Olson
- Chad Orn
- Jason Petryszyn
- Art Rhode
- Scott Rising
- Lon Romsaas
- Dennis Sailer
- June Skuza
- Donna Schauer
- Robert Schauer
- Steve Smokey
- 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.

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.

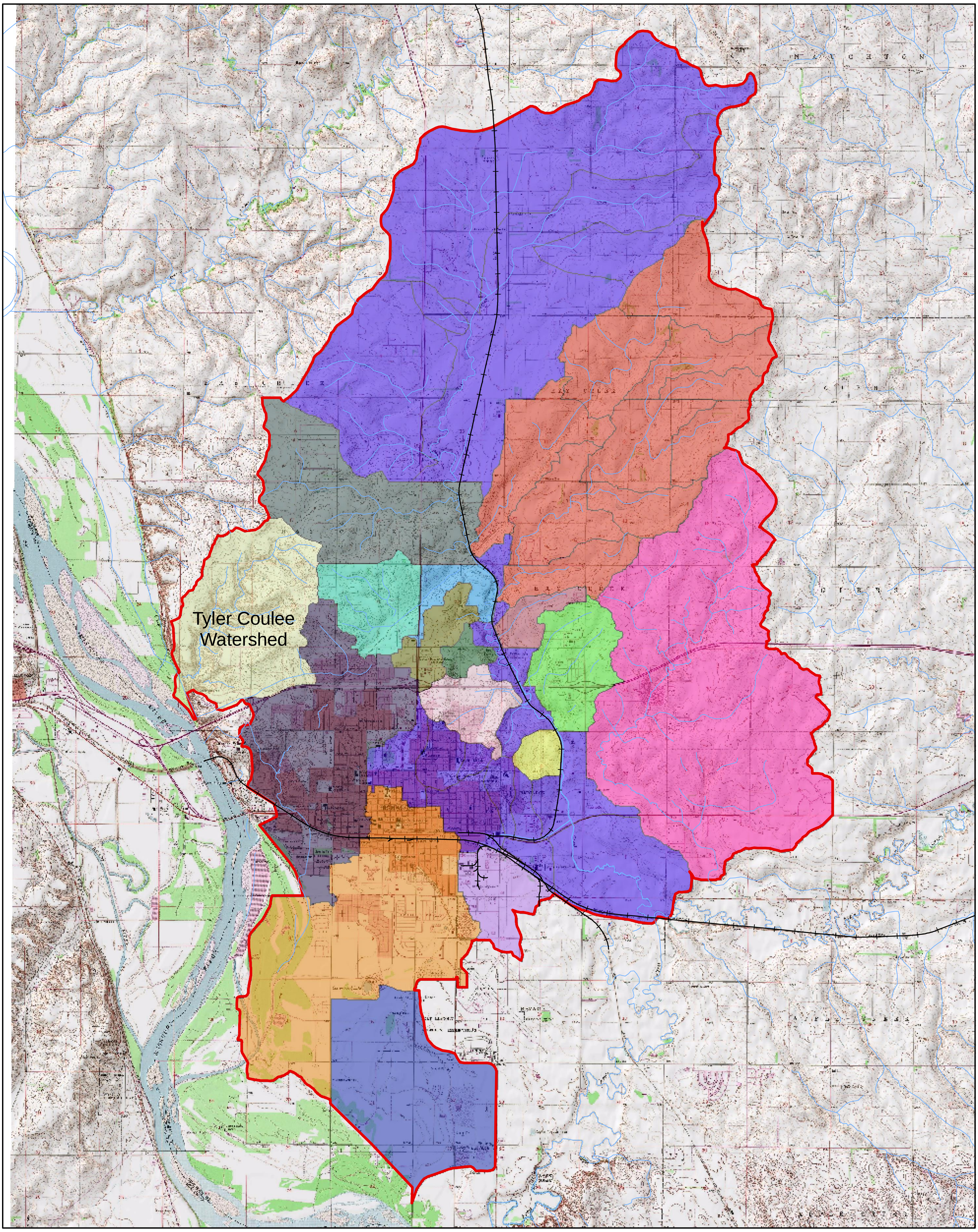

FIGURE 1.0 - LOCATION MAP

Legend

Streams
Railways
Bismarck Watershed Coverage

Name

Capitol Avenue
Centennial
Hay Creek
Hay Creek HC 3-3, 4-6, 5-3
Jackman Coulee
Landfill
North 19th Street
North 4th Street
North Valley
North Washington Street
Pebble Creek
Shannon Valley
Sloven Slough
South 12th Street
South Bismarck
Tyler Coulee
US Health Care

7,600 3,800 0 Feet

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

TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA

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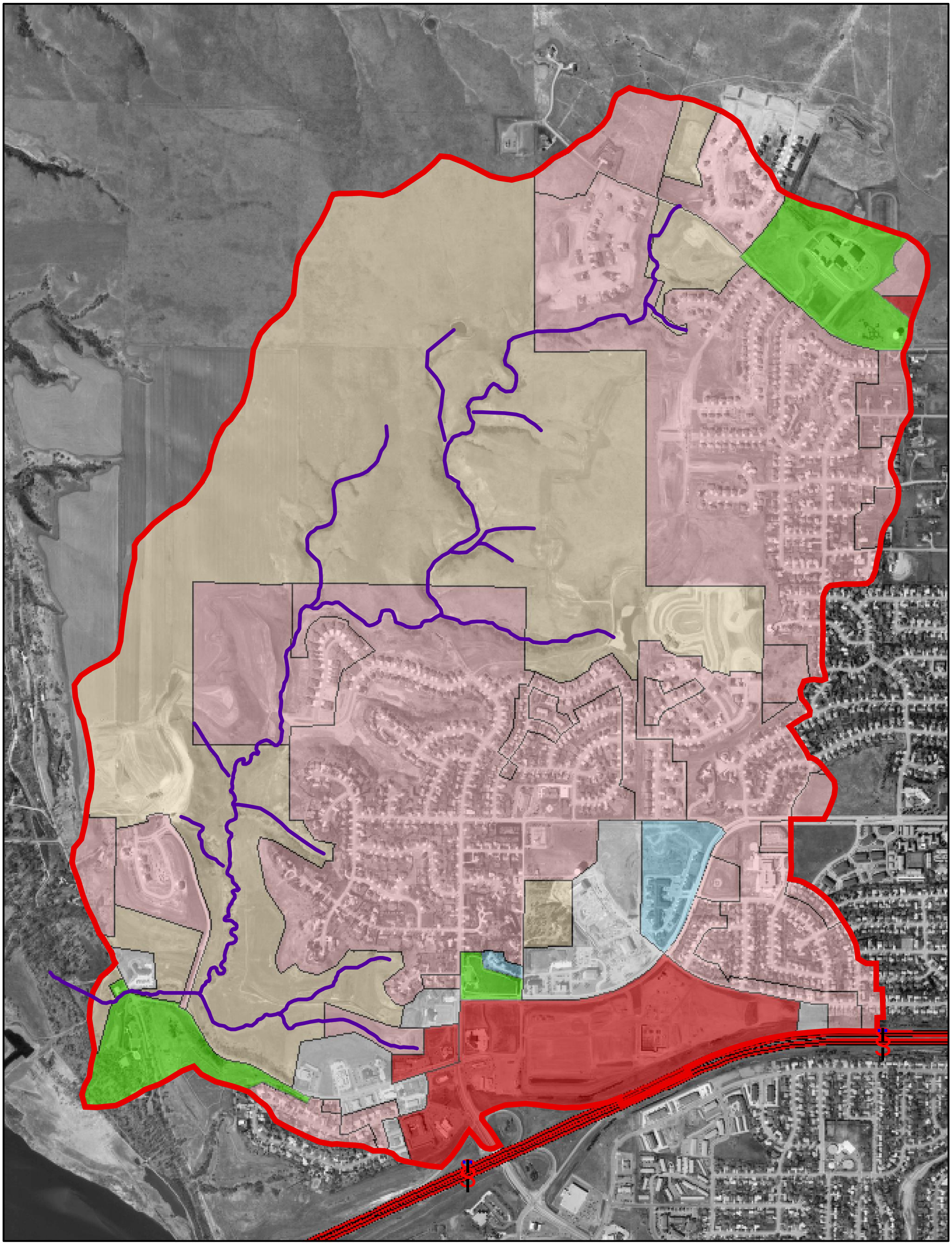
Q:\GIS\Projects\City of Bismarck\Tyler Coulee\Figure 1.0 Location Map.mxd



Major Watershed Boundary
Stream Channel (digitized by Houston Engineering)

Major Roads
Interstate
State Highway
US Highway

Zoning Districts
Agricultural
Comercial
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
2

0 270 540 1,080 1,620 2,160 Feet

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 gage 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 where 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 flows:

- 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**.

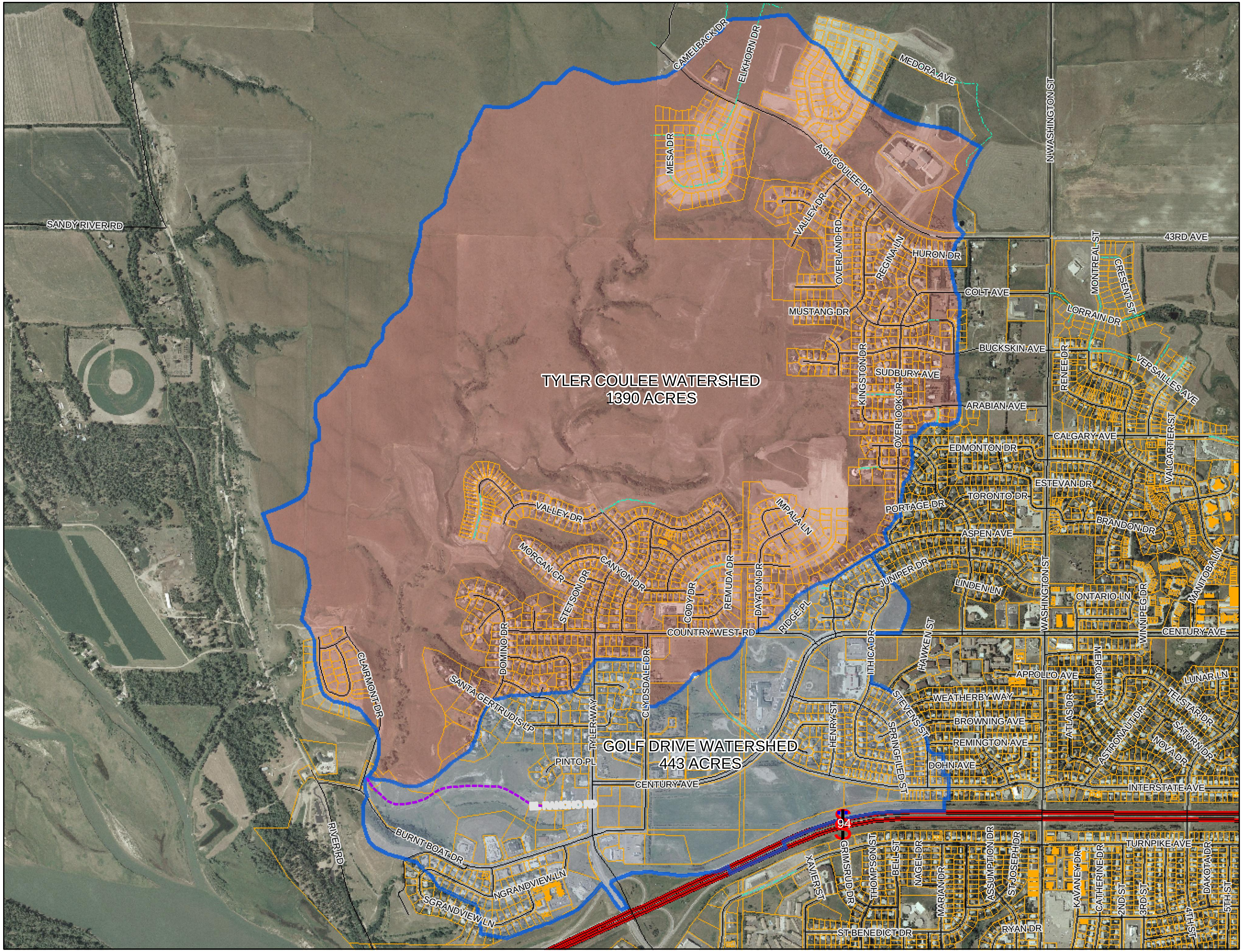
One issue of special interest addressed during the FWG and MPWG meetings was future development and related costs for any project located within what is known as the Golf Drive Corridor. A 1996 project proposal for a storm water assessment district met with considerable community resistance and controversy. 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

0 325 650 1,300 1,950 2,600
Feet

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: 3-23-06

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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**.

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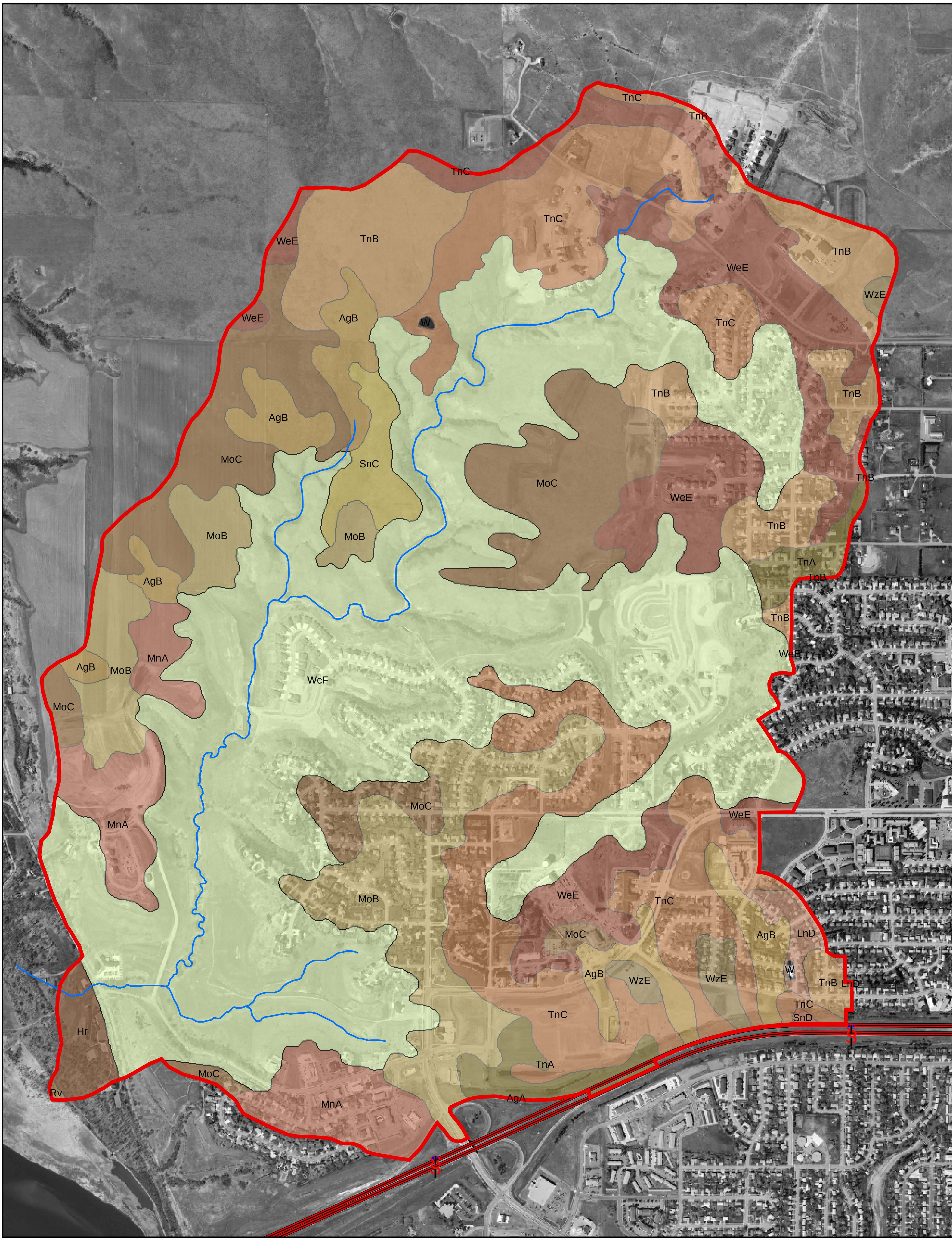

Legend

- Major Watershed Boundary
- Stream Channel

Major Roads

- Interstate
- State Highway
- US Highway

- ARNEGARD AND GRASSNA SILT LOAMS, GENTLY SLOPING (B)
- ARNEGARD AND GRASSNA SILT LOAMS, LEVEL (B)
- HAVRELON 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
- 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)

0 550 1,100 2,200 Feet

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

FIGURE 3.1.1.1
GIS SOILS MAP

TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA

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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**.

Table 3.1.2.1
Soils Conditions and Approximate CN Values

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**.

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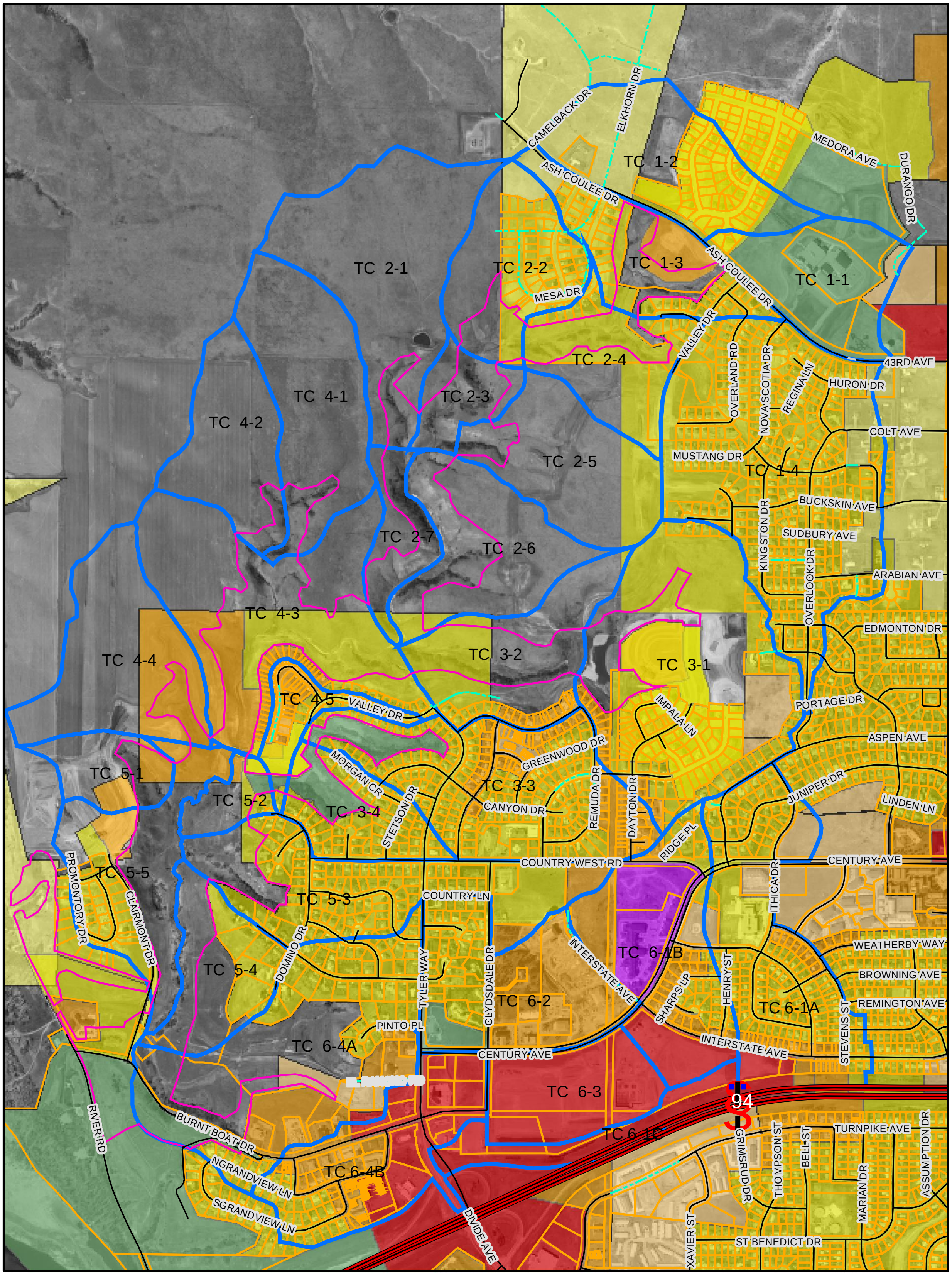

Legend

- 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

2

0 250 500 1,000 1,500 2,000 Feet

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

2005 ZONING AREAS

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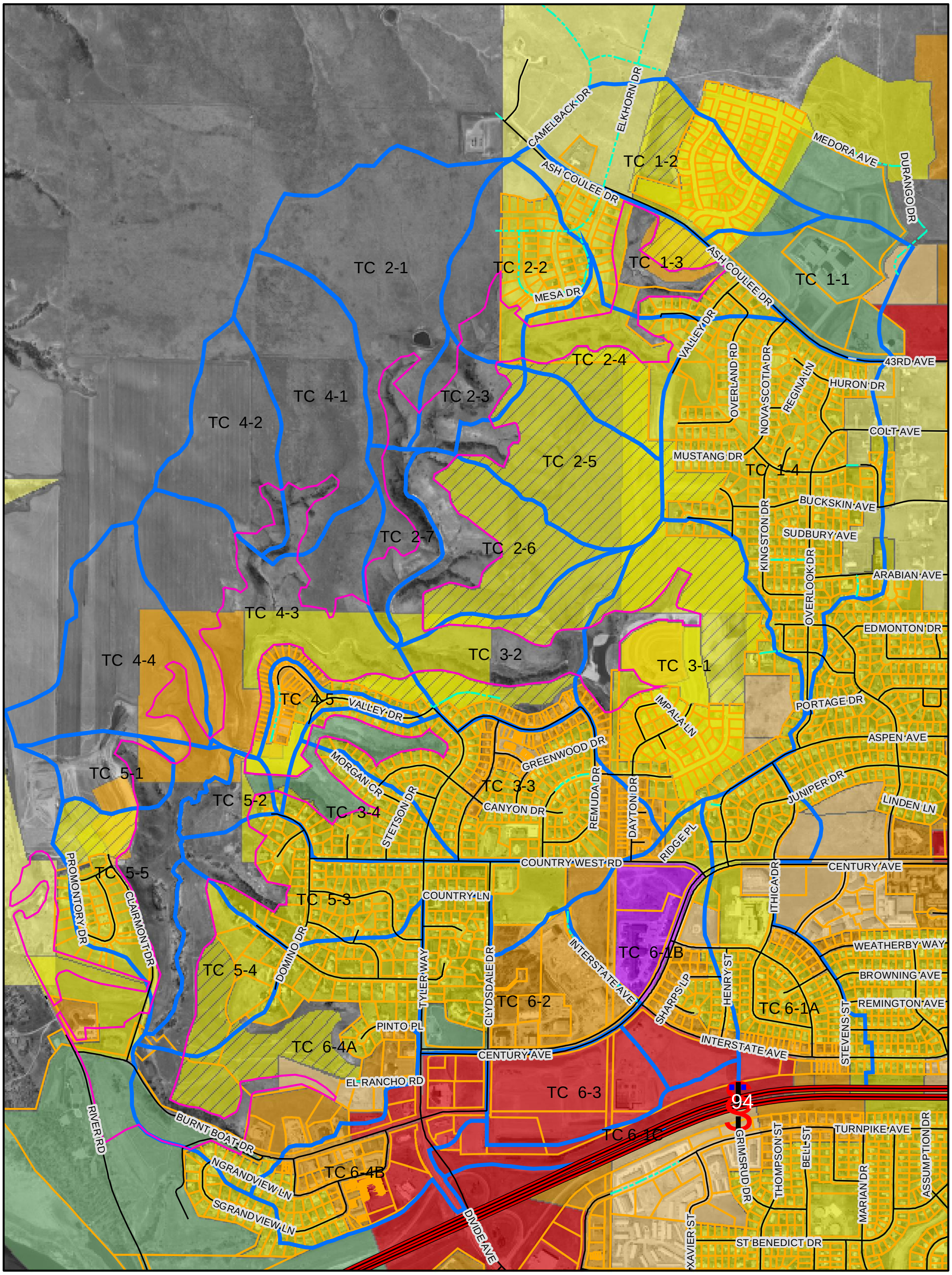

Legend

- 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

Tyler Coulee Waterhsed
Storm Water Master Plan
Bismarck, North Dakota

FIGURE 3.1.2.2
2015 LAND USE ZONING MAP

2

0 250 500 1,000 1,500 2,000 Feet

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

2015 ZONING AREAS

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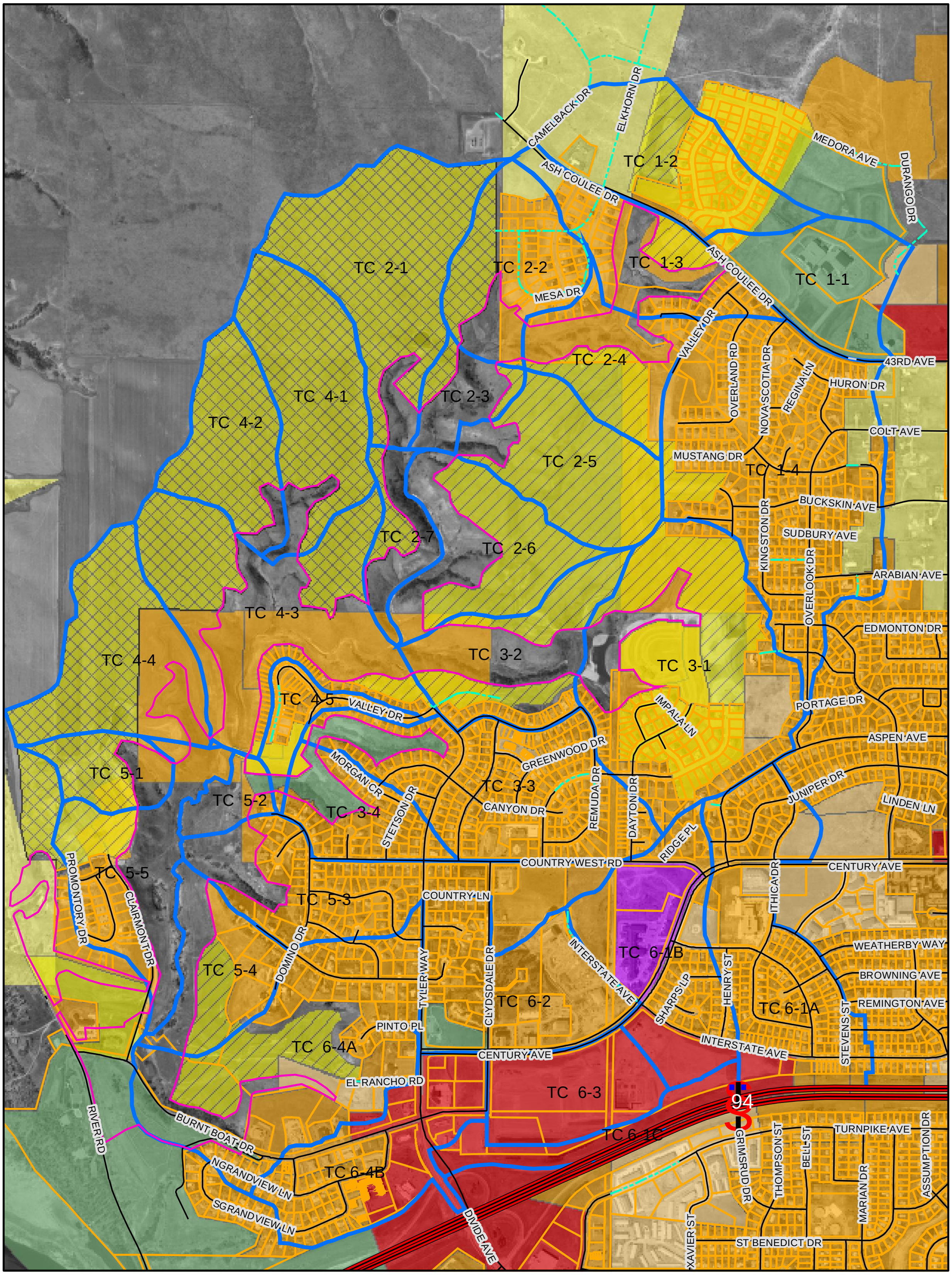

Legend

- 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

Tyler Coulee Watershed
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Bismarck, North Dakota

FIGURE 3.1.2.3
2025 LAND USE ZONING MAP

2

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

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

2025 ZONING AREAS

Scale:	Drawn by:	Checked by:	Project No.:	Date:	Sheet:
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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

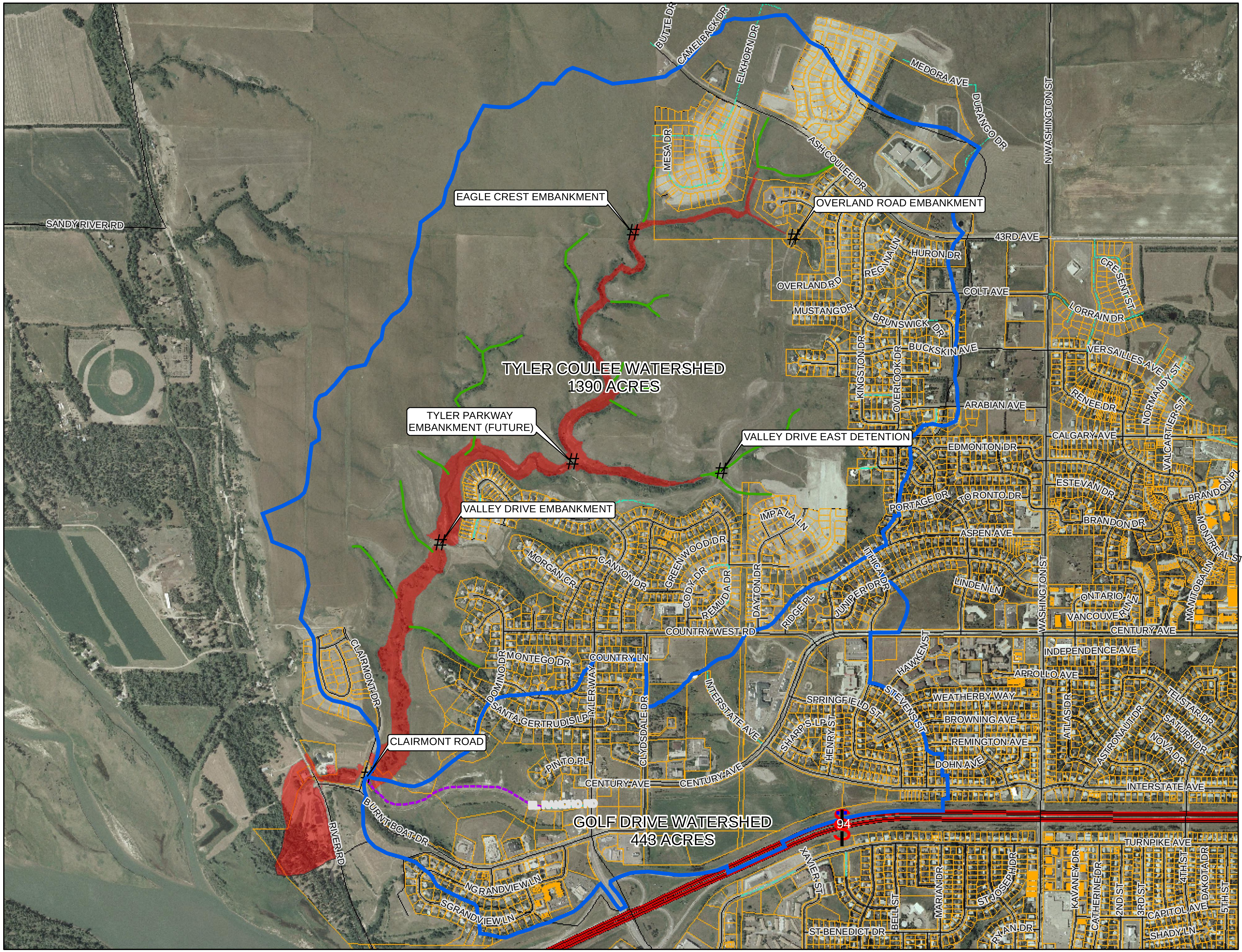
A Corps of Engineers (COE) permit is also required for the construction of the stream crossings within this watershed. While the COE permitting process will require an environmental review this is not anticipated to create a scenario whereby construction could not occur. As a point of interest the MPWG 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

0 335 670 1,340 2,010 2,680 Feet

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

Houston Engineering, Inc.
3712 LOCKPORT STREET
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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

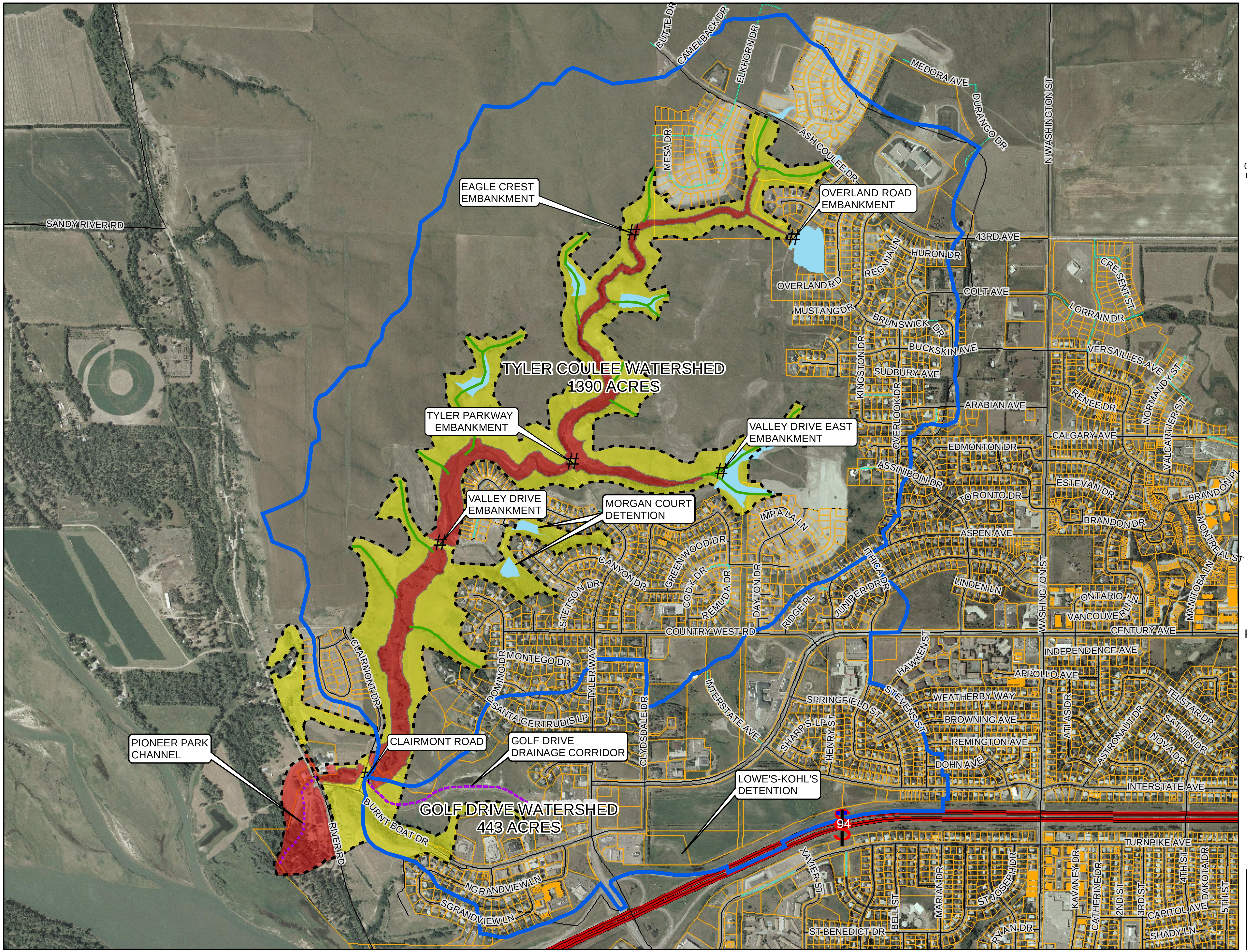
Based on the hydrologic and hydraulic analyses, NDSE dam design standards, and input obtained from public informational meeting and citizen work groups the recommended components of the Preferred Alternative include the following regional facilities:

- 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
Storm Water Master Plan
Bismarck, North Dakota

3

0 350 700 1,400 2,100 2,800 Feet

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

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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

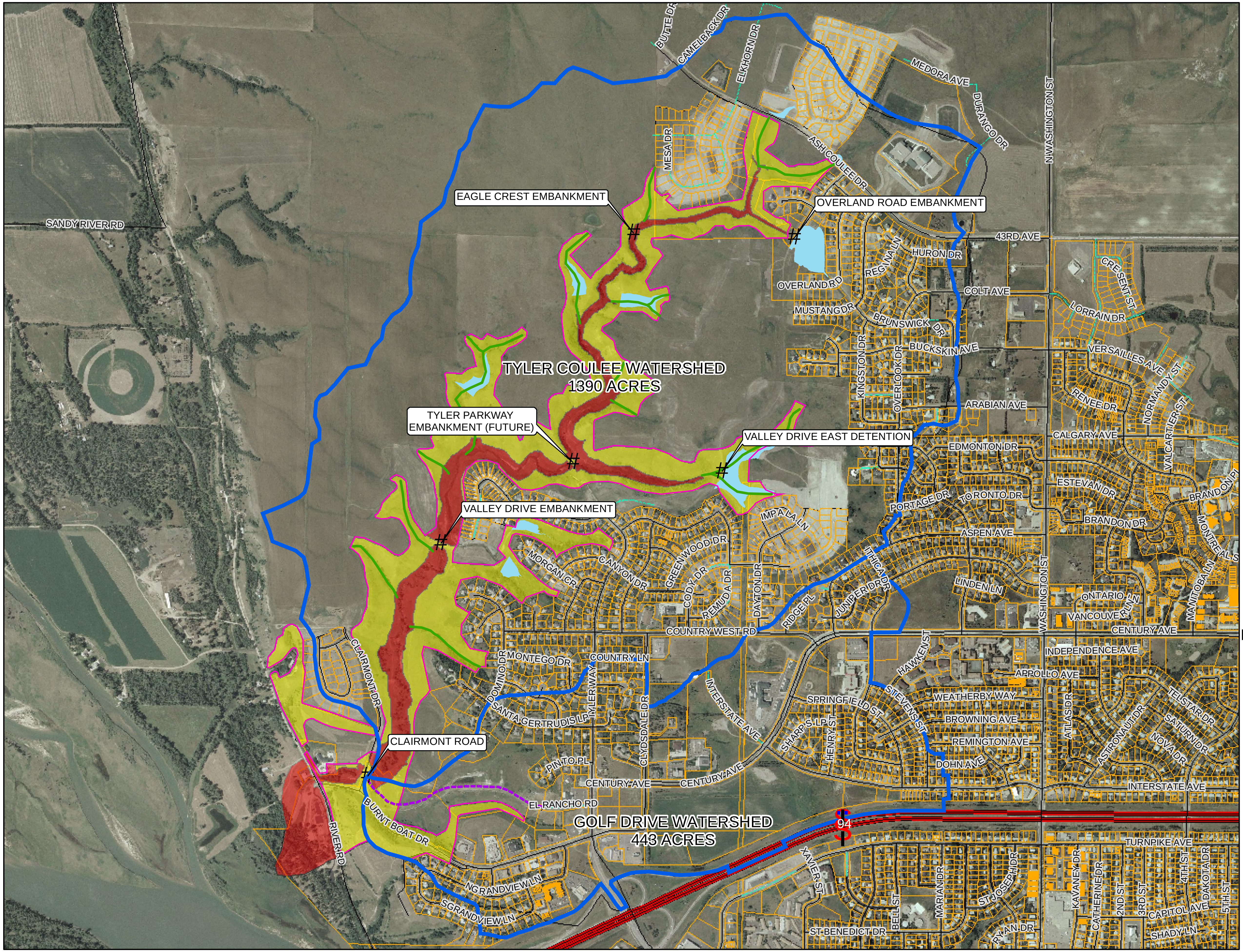
The Pioneer Park Channel was designed to accommodate somewhere between a 2-year and 5-year 6-hour runoff event. The Preferred Alternative will not materially increase the peak flows at this location, which was a concern voiced by the BPRD. The Preferred Alternative also does not include or recommend 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



0 340 680 1,360 2,040 2,720
Feet

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

Houston Engineering, Inc.
3712 LOCKPORT STREET
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TEL: (701) 323-0200
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- 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 <u>may</u> 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 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	• 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.	• 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.	• 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	• 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	• Not project specific • May not be politically saleable • Hard to match charges to benefits	• Clearly define the intended purpose for the fund and expectations for its use
Special Assessments	• Project specific • Bondable • Can use be blended over several projects • Can use formula	• Can't be levied outside City of Bismarck • Additive to property taxes	• Combine with other options • Could be held in abeyance for property outside City if "bank" is available for financing
Impact Fee	• 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	• 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.	• 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	• If funding available, could be project bank	• Other competing interests: bridge and other projects	• Cost analysis and explanation • Funds committed through 2008 • Additional Tax Could be authorized
Grants	• Did get FEMA grant for Jackman Coulee • Section 319 Grant Funding Obtained for Hay Creek Corridor Study – Capitol Avenue Outfall	• Grants usually tied to flooding or other natural disasters. • Water quality grants available, however, demand for available funds is high	• 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 is 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 there 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.

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX A

Stakeholder Involvement Program

C- Family Trust – November 21, 2003
Bismarck Parks & Recreation District – December 10, 2003
Bill Clairmont – December 21, 2003

William Clairmont (C-Family Trust) - Stakeholder Meeting
Tyler Coulee Watershed Evaluation Update
November 21, 2003

Attending: **William Clairmont, C-Family Trust**
Fay Connell, C-Family Trust
Lon Romsaas, Swenson, Hagen & Co. (SH)
Michael Gunsch, Houston Engineering, Inc.

The purpose for this meeting was to gather information related to Mr. William Clairmont's (C-Family Trust), development plans for their property ownership located within the Tyler Coulee Watershed. Numerous issues were discussed, some at length and others briefly, depending upon the nature of future development and timing. The following summarizes the key issues or elements raised. Mr. Clairmont, through his engineering consultant Swenson, Hagen & Co., presented the attached issue paper dated November 21, 2003 outlining short and long term goals and concerns.

Valley Drive Embankment/Roadway

It is Mr. Clairmont's intent to move forward with construction of Valley Drive leading up to this embankment from Mesquite Drive, located to the east, early in 2004. This will require establishing the proposed street gradients up to and over the Valley Drive Embankment. Several key decisions need to be made before moving forward such as:

- **Desired or required top of embankment elevation** – This was discussed and noted that the selected elevation will be the maximum allowable to optimize upstream storage to reduce the spillway requirements for the 0.5 PMP event emergency spillway sizing. This elevation is dependent upon the proposed grading of lots north of Valley Drive and west of Mesquite Loop. The lowest back yard elevation was noted as 1716 by Mr. Romsaas. Some residences to the north already have basements or are walkouts. The 2002 Master Plan projected a 100-year floodplain elevation of 1704.0, which is below the basement floor elevations. This elevation is the result of a 24" RCP inlet control pipe, a 72" RCP riser and a 48" RCP principal spillway.

- **Emergency Spillway Location** - The location and final size needs to be determined. Both the eastern and western locations were discussed. The plan and profile sheet presented by SH shows two lots located on the west abutment. These were developed to assist in the repayment for the roadway and utilities and require the placement of fill both downstream and upstream from the embankment. A reduced copy of this information is attached. It was noted the State Engineer's (SE) criteria would possibly require the western location be used for the emergency spillway as it is more suitable in width and slope for connection to the downstream channel. The profile provided by SH notes an overflow elevation of 1707.8. It is anticipated this is likely to be closer to elevation 1710 to allow the spillway to be placed underneath the roadway while maintaining 100-year flow control.

- The existing 48” RCP principal spillway will need to be extended and the slopes flattened at least to 3:1 and possibly to 4:1 to improve embankment stability and provide better access for maintenance. A preliminary extension option was noted on the plans provided by SH. The final extension upstream is likely to include a two stage riser section. This will be sized later in the master plan study.

- Street grades entering from the east and over the embankment need to be determined. This requires establishing a vertical and/or horizontal curve or alignment over this embankment. Based on the plan sheet provided the embankment width would be approximately 52 feet at its narrowest with a sidewalk or pedestrian trail located on one side.

- A preliminary design layout for the Morgan Court Storm Sewer System should be completed. This system will need to convey flows from the upper elevations on Valley Drive down the slope and into Tyler Coulee. This is a considerable drop; therefore, energy dissipation is required at the bottom. One option is a direct connection to the principal spillway culvert. It was not known who will be designing this storm sewer system.

- The extension of Valley Drive across the embankment was discussed and is to be addressed in the final report. The use of the properties west of the embankment will be addressed once a determination has been made regarding the design of this embankment and associated spillways.

- The utilization of a Tyler Parkway Embankment to control the inflows from the 0.5 PMP flood event was discussed. The intent here is to possibly control these flows to reduce the size of the principal spillway at Valley Drive. The SE’s criteria will impact the ability and use of this alternative. It is anticipated a breach analysis could be required for this embankment as well as Valley Drive.

- The probable costs and/or benefits from the Tyler Parkway Embankment alternative will be evaluated with the Valley Drive Embankment Assessment. The development of this embankment as a future arterial street was also discussed. It was noted the full embankment would not be required to provide the desired flow control benefits at Valley Drive. A preliminary profile for the future Tyler Parkway arterial street was provided by SH.

- Several ideas regarding possible cost distribution for the Tyler Parkway Embankment were discussed. These may be similar to prior arrangements; however, this is a determination to be made by the City.

- It was noted the soils evaluation completed for Valley Drive at the time the work was being completed on Clairmont Road has been provided and is under review.

Golf Drive Development Area

The development of the Golf Drive Area east of Clairmont Road is scheduled for the fall of 2004 and into 2005. This area has a number of issues which will need to be evaluated to determine the configuration of any potential development. A summary of these issues are as follows:

- The extension of Golf Drive is restricted to 800 feet from Tyler Parkway, given the City of Bismarck ordinances on cul-de-sac lengths, unless a second access is provided to Burnt Boat Drive, Clairmont Road or Valley Drive.
    - A direct connection to Burnt Boat Drive was deemed impractical due to grade differential given the location of its intersection of Clairmont Road.
    - A connection to Clairmont Road to the south of the 84" RCP culvert was deemed undesirable due to grading and its proximity to the intersection with Burnt Boat Drive.
    - A connection to Clairmont Road north of the 84" RCP was proposed noting the projected culvert to accommodate flows from Tyler Coulee discharging from the Valley Drive Embankment area would be a 78" RCP. This layout and proposed grading was presented on a plan sheet by SH. A reduced section of this sheet is attached.
        - It was noted this roadway location was selected so as not retain more than 25 ac-ft and, therefore, not subject to the SE's design criteria. This determination was not verified.
        - This proposed roadway location would result in the filling of a considerable portion of the storage area within the backwater area from Clairmont Road. Pursing this alternative will require an evaluation of the impact this storage reduction will have on overflows at Clairmont Road.
        - A discussion was held regarding the proposed floodplain delineations and SE's breach requirements for the reach from Valley Drive to Clairmont Road along Tyler Coulee. The floodplain and breach zone designation will restrict and/or limit development in this area. The extent of this has not been determined. The primary issue, with a breach, is the risk for loss of life and damage to structures due to the rapid release of stored floodwaters.

    - A proposed development layout using the roadway connection upstream from Clairmont Road on Tyler Coulee noted street grades of approximately eight percent and anticipated yard elevations. The top of the proposed street elevation would be at or below the top of Clairmont Road.

    - The proposed layout requires relocating the drainage channel from the 72" RCP outfall at Tyler Parkway and Burnt Boat Drive to Clairmont Road. This channel would be placed along the toe of the Burnt Boat Drive which appeared to restrict the side slope to their present conditions. Concerns were discussed related to the impact this location would have on Burnt Boat Drive. It was noted by Mr. Romsaas that this layout will work from a slope and grading perspective.

    - It was noted the proposed layout requires the placement of fill within the storage area behind Clairmont Road. Pursing this layout will require an evaluation of the impact this storage reduction will have on overflows at Clairmont Road.

  - A proposed street connection from Golf Drive north to Valley Drive was discussed and a concept map was reviewed, but not provided. It was noted this idea has been discussed with the City as it relates to traffic issues; however, the development of lots along this roadway was limited due to existing topography.

<u>General Watershed Development</u>

A general overview of the issues related to development of Storm Water Management Alternatives was discussed, including the following:

- The options and ideas for regional stormwater detention areas versus local control facilities. Based on a development perspective local storage is easier to develop and even preferred given current available funding methods. This also fits better with the development of smaller parcels rather than large tracts of lots.

- Mr. Clairmont noted concerns relative to the assessment of undeveloped properties under a Watershed District. These properties cannot afford the additional taxes that might be applied to cover the cost for regional systems. One concern was that the total costs would be equally distributed to all properties, which would be higher for undeveloped properties.

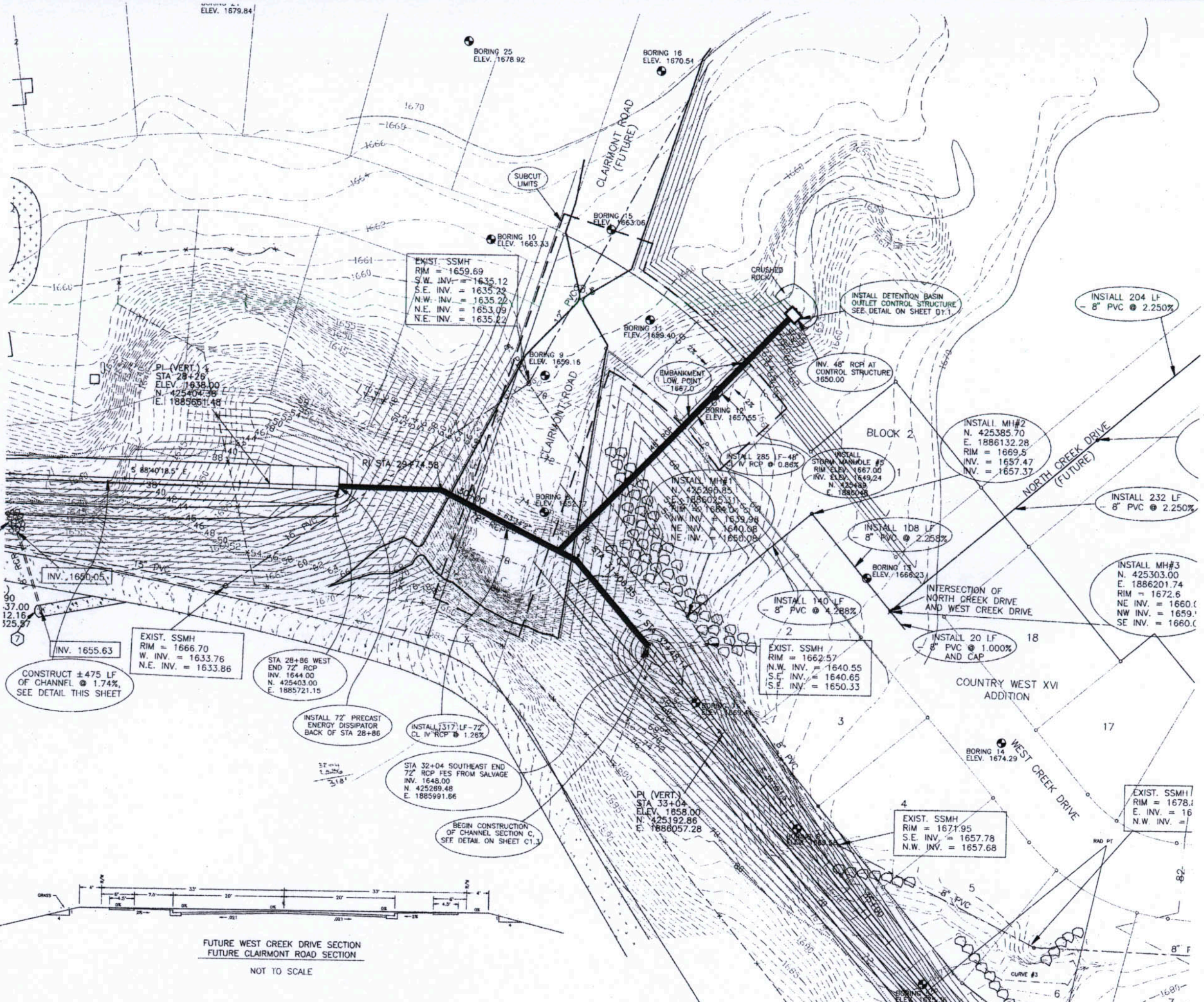
- Mr. Clairmont noted holding the expenses associated with a regional storage in abeyance until development occurs was seen as a viable option. The question remains how this can be accomplished or implemented.

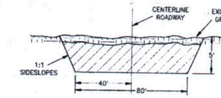
- The design plans for the Valley Drive East Embankment and layout for the development along the future Valley Drive to the north along Tyler Coulee were requested and have since been received from SH.

- Mr. Clairmont noted his understanding of the undevelopable properties and green space issues. His concern was dedicating lands for preservation, which have the potential to be developed, should only be completed through adequate compensation or credit for their full value.

- The creation of permanent pools within the detention storage areas was discussed. It was noted several locations have the potential to enhance local values for the permanent storage of waters. This was seen as a positive move in some locations.

- Mr. Clairmont was informed that a set of minutes for this meeting would be prepared and provided to the City of Bismarck.





EMBANKMENT SUBCUT DETAIL

NOT TO SCALE

CONSTRUCTION NOTES

1. CLEAR AND GRUB EXISTING TREES AND BRUSH WITHIN THE CHANNEL OR EMBANKMENT CONSTRUCTION AREA. ALL COSTS TO BE INCLUDED IN CLEARING AND GRUBBING.
2. STRIP 6" OF TOPSOIL FROM ALL AREAS TO BE DISTURBED. RESPREAD WHEN GRADING OPERATIONS ARE COMPLETE.
3. SEED AND MULCH ALL DISTURBED AREAS, TYPE I SEEDING.
4. PRIOR TO PLACEMENT OF EMBANKMENTS, THE EXISTING SOILS IN FILL AREAS SHALL BE SCARIFIED TO A DEPTH OF 12" AND RECOMPACTED PER SPECIFICATIONS. ALL COSTS INCIDENTAL TO EXCAVATION.
5. CONTRACTOR SHALL VERIFY LOCATIONS OF ALL PUBLIC AND PRIVATE UTILITIES.
6. CONTRACTOR SHALL GRADE THE CLAIRMONT ROAD EMBANKMENT TO AN ELEVATION OF 1668.5. FUTURE CONTOURS FOR CLAIRMONT ROAD ABOVE 1668.5 ARE PROVIDED FOR REFERENCE ONLY. WEST CREEK DRIVE SHALL BE GRADED TO THE ELEVATIONS SHOWN.
7. REMOVE EXISTING ASPHALT CURB ALONG THIS SECTION OF BURNT BOAT DRIVE AND INSTALL A 10' WIDE X 6" THICK ASPHALT PAVEMENT LINED CHUTE DOWN TO THE EXISTING 18" RCP. SHAPE AREA TO PROVIDE POSITIVE DRAINAGE FROM ROADWAY EDGE TO RCP. ALL COSTS FOR SHAPING, REMOVING ASPHALT CURB AND OTHER ITEMS INCLUDED IN THE UNIT PRICE BID FOR ASPHALT.
8. THE AREA WITHIN THE SUBCUT LIMITS SHALL BE STRIPPED OF TOPSOIL AND THEN SUBCUT TO A DEPTH OF 5' BELOW EXISTING GRADE AND REFILLED WITH SUITABLE EXCAVATED OR BORROW MATERIAL. ALL SUBCUT MATERIAL SHALL BE WASTED ON AREAS DESIGNATED BY OWNER. MATERIAL SHALL BE WASTED IN THIN LIFTS NOT TO EXCEED 12".
9. INSTALL 18' WIDE RIPRAPED DRAINAGEWAY FROM 18" RCP TO RIPRAP IN CHANNEL.

FUTURE WEST CREEK DRIVE SECTION
FUTURE CLAIRMONT ROAD SECTION

NOT TO SCALE

0' 20' 40'

REV.	DATE	DESCRIPTION	BY

BISMARCK SEWER IMPROVEMENT DISTRICT #348
COUNTRY WEST/PIONEER PARK DRAINAGE IMPROVEMENTS

WEST CREEK DRIVE/CLAIRMONT ROAD GRADING PLAN

ULTEIG ENGINEERS, INC. CONSULTING ENGINEERS FARGO • BISMARCK • MINNEAPOLIS

DRAWN BY: TRB	SCALE: AS SHOWN	PROJECT NO. 96845	
CHECKED BY: KEN	DATE: OCTOBER, 1996	SHEET G1.1	
APPROVED BY:			

Bismarck Parks and Recreation District - Stakeholder Meeting
Tyler Coulee Watershed Evaluation Update
December 10, 2003

Attending: **Steve Neu, Bismarck Parks & Recreation District**
Lisa Ansley, City of Bismarck
Michael Gunsch, Houston Engineering, Inc.

The purpose for this meeting was to gather information related to the Bismarck Parks and Recreation District's interest in the retention of green space within the Tyler Coulee Watershed. Numerous issues were discussed, some at length and others briefly, depending upon their nature. The following minutes summarizes the key issues or elements raised.

Pioneer Park Storm Water Channel

Steve Neu noted the recent investment in the Pioneer Park Storm Water Channel and FEMA Grant used for construction. These facilities need to be protected from additional or increased peak discharges from future development within the Tyler Coulee Watershed. The capacity of this channel is based on the 2002 Tyler Coulee Master Plan; however, lower peak flows are desired, if practical.

Golf Drive Area – This area was the primary area of discussion

- Proposed Development Layout along Golf Drive by C-Family Trust
  - Relocation of sanitary sewer, water line storm water channel.
  - Proposed development layout and concerns were discussed.
  - Maintenance issues were noted as a concern.
  - The deep rock riprap high velocity channel and grade stabilization structures to be located behind the proposed residential lots was noted as an undesirable situation.
  - The development of the floodplain and flood breach impacts will need to be made to define undevelopable areas. What happens in these bottom lands is likely to affect the entire area.

- Bismarck Park and Recreation District Proposal
  - Alternative conveyance system of pipes, channels, and ponds from Tyler Parkway/Burnt Boat Drive intersection to Clairmont Road. A layout developed by KLJ was reviewed and provided to the City for discussion. This alternative was being considered by Mr. Clairmont, but he has since declined to accept or consider it further.

- The BP&RD proposal would result in development north of the street and green space to the south. (Bill is still willing to consider this alternative, but not willing to donate 110% of the property to BR&RD)
- Condo vs. Single Family Residentials is anticipated north of the street. This would be a change in density that might work to develop considerable property values in this area. The return on investment issue here might be the number of units that can be created per acre of developable property.
- One side street development costs along with the distribution of assessments by the BP&RD would be City-wide - though split options were not verified – the City will look into this and evaluate what it might signify.
- The idea to extend Golf Drive and connect to River Road to replace Burnt Boat Drive was discussed. This idea has not been reviewed at any length; however, it has been tossed around.
- While discussed a specific dollar value to purchase all or part of the Golf Drive properties from the C-Family Trust has not been established. This alternative would possibly require funds from the City, BP&RD, BCWRD and perhaps others.

- The traffic patterns related to Burnt Boat Drive, Clairmont Road and the limitations associated with Golf Drive, without a secondary access location, were discussed.

General Watershed Development

A general overview of the issues related to development of Storm Water Management Alternatives was discussed, including the following:

- The development of Jennifer Anderson's property east of McDonalds and south of Century Avenue was noted as a concern. The additional development will generate even higher peak flows into the Golf Drive Area. These peak flows need to be retained or, if possible, reduced below present levels. It was noted prior reviews indicated this larger tract of commercially zoned property would require approximately three acre-feet of detention storage. In addition it was noted the Tyler Coulee 2002 Master Plan called for a reduction in the size of the inlet from the Interstate #94 Interchange. This would create additional storage and result in reduced flows downstream. The viability of this action was not verified or confirmed with the NDDOT.

- Information was requested on the design plans for the Pioneer Park Storm Water Channel. This channel, constructed in 2002-2003, is a limiting factor as to the desired discharges from the watershed. It is not known at this time what the full extent of peak reduction might be obtained through a fully implemented master plan. *Note for the record - an e-mail request has been sent to Tom Kary at KLJ.*

- Development along streams, tributaries and outfalls was discussed. Steve Neu noted the North 4th Street outfall north of the Century Park Ball Diamonds as a prime example of what should not be done or allowed to occur.

- Steve Neu noted that the South Washington Street Storm Water Cannel in South Bismarck has a well defined buffer zone that has worked well. Lisa Ansley noted the City has concerns related to open channels that do not dry out, but agreed with the need for an adequate buffer zone. This buffer zone would provide an enhancement or amenity for the green space located along these areas.

- The City of Bismarck's undevelopable lands policy was discussed. The question was raised as to if this was still a just "policy" or if it had been adopted as a formal ordinance change. *An inquiry after the meeting noted this is still only a policy and has not been adopted as an ordinance.*

- Steve Neu noted unplatted lands are still agricultural lands as far as an appraisal is concerned, though they may have development potential. The value of such properties must consider the input or investment required, (i.e., grading, storm sewer, sanitary sewer, water, streets, and other utilities) to increase their value to saleable lots in order to determine a true and fair valuation. It cannot be assumed that a parcel has a saleable value prior to these inputs that is equal to another lot where platting and improvements have been completed.

- The value of donated properties should be adequately evaluated given their development potential and input costs. Is 60% developable or is it 80%, and what are the inputs required.

- The option of regional versus local stormwater retention was discussed. Development sizes, annexation and funding appear to be the limiting or driving factors in this issue. Smaller local or on-site storage (i.e., Cracker Barrel) should be considered or implemented even without a global evaluation. A costs accounting system may be required to determine what costs apply to what properties if regional development programs are to be considered.

- The BP&RD noted they preferred a pedestrian path be located on the north side of Valley Drive. Additional viable trail locations and corridors need to be established within this watershed.

- Lisa Ansley noted the desirability for a detention area in Watershed TC-2. This is the Eagle Crest Subdivision and no detention was offered or incorporated into the storm water management plan for this plat. Thus the downstream channel is subjected to additional flows. The major concern is the stability of this channel and potential erosion.

- Green Space is more valuable as a continuous strip than as scattered pieces. The one issue to be considered here is the option of a storm water easement or ownership, by either the City or BP&RD. The primary direction appeared to be ownership where any detention storage is created. This to include any desired buffer zone.

- Steve Neu noted a concern with the application of a Development Control Line (DCL). This was that the platted lot lines should be placed to limit the pushing of soils over and down the slopes to expand the back yards or usable lot area. This occurred around the Pebble Creek Golf Course area on Hay Creek and is unsightly and undesirable. How this can be avoided in Tyler Coulee should be evaluated.

- The creation of permanent pools within the detention storage areas was discussed. It was noted that several locations have the potential to enhance local values for the permanent storage of waters. This was seen as a positive move in some locations.

- Steve Neu was informed that a set of minutes for this meeting would be prepared and provided to the City of Bismarck.

Bill Clairmont Stakeholder Meeting
Tyler Coulee Watershed Evaluation Update
December 21, 2003

Attending: Bill Clairmont, Lon Romsaas, Michael Gunsch

Introduction –
Goals and Objectives – Establish a List of Key Issues and Concerns

Key Issues and Concerns

- **Elevation of Roadway Embankment over Valley Drive (Immediate Need)**
    - **Valley Drive - Needs to be first project and related issues**
    - Eastern section needed in order to design roadway and storm sewer
        - Discharge upstream from Valley Drive
        - Convey flows to channel elevation
        - Outfall Structure
        - Overflow during flooding
    - 2004 projects need to be designed now?
    - Ground elevation at southern most lot – 1713 (Basements are allowed)
        - Mesquite Loop/Valley Drive
    - Top of Embankment Limitation is 1710?
    - Existing embankment at 1708±
    - Available Storage increases significantly above 1708

- **Valley Drive Embankment Design Issues**
    - Overflow Elevation (top of roadway)
    - Emergency Spillway Elevation and Size
        - East or west side location
        - Native Material
        - Slope to Creek
        - Impacts to existing or future lots
        - Land costs for spillway location
    - Upstream Slope 4:1
    - Downstream Slope 3:1 (spillway impacts)
    - Culvert Extensions – Upstream and Downstream
    - Concept Design – Inlet Configuration
    - Geotechnical Design & Existing Conditions
        - Existing Fill Compaction (Breach issue)
        - Permeability
        - Piping along Principal Spillway

- **Valley Drive Roadway Section**
  - 32 foot paved width
  - 4 foot sidewalk on north side
  - 6 foot pedestrian path on north side
  - Grass buffer width to street 4 feet each side? (City Determination)
  - Total top width = 32 + 4 + 6 + 8 = 50 feet

- **Tyler Parkway Embankment Alternative**
  - 100-year Storm Water Control?
  - 0.3 PMP Control?
  - 0.5 PMP issue – Height may exceed 40 feet (Roadway Design?)
    - Street Grades and Alternatives
  - Backwater impacts on upstream structures
  - Embankment Design Issues
    - Side Slopes
    - Roadway Section for this Arterial Street (40 feet?)
    - R/W Requirements
    - Height for storm water control vs. roadway uses
    - Street profile and grades
    - Phased Construction (storm water first then street)

- **Upstream Storage Sites – one possibly two – Location Unidentified**
  - Locate so as to not cause backwater on existing sites
  - Knudson Development – Direct Discharge
  - Mitzel Development – Storage Provided
  - Existing Embankment on Valley Drive
    - Low Pipe and Riser Design – Question on height to overflow
    - 0.3 PMP Criteria – Roadway not completed to south – timing?

- **Other Issues and Concerns**
  - Development within the Floodplain and Breach Zones
    - Valley Drive to Clairmont Road
    - Issue of roadway upstream from Clairmont Road
      - 78”RCP – Older Design Concept
    - Green Space Issue – Development Control lines

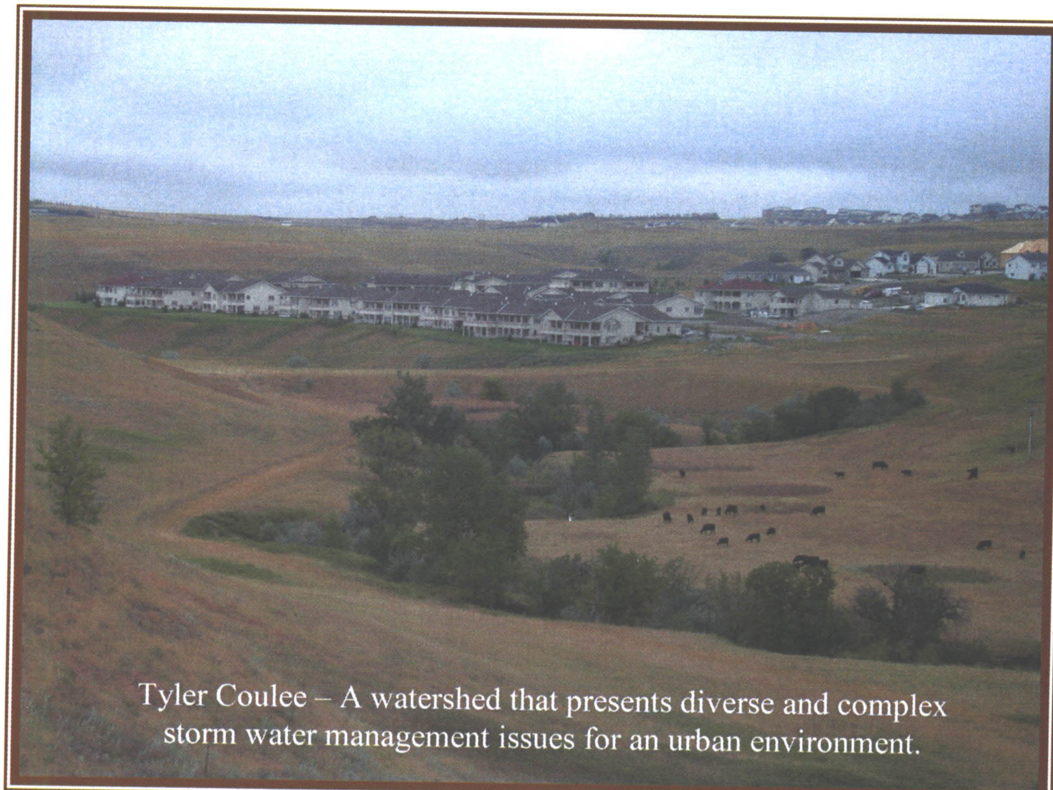
- **Bismarck Parks and Recreation Issues Downstream**
  - Pioneer Park Channel – Design Capacity
  - River Road Capacity
  - Clairmont Road – overflow

- **Project Assessments and Cost Issues**
  - Funding Options and Sources
  - Undeveloped Land Assessments (do not assess?)
  - Annexed Properties
  - Land costs in project estimates
  -

- **Information Requested**
  - Valley Drive Area – Preliminary Plat Layouts
  - Tyler Parkway – Preliminary Street Profile across coulee
  - Other concept platting along Valley Drive to north
  - Any other concept platting within the watershed
  - Design Plans for Valley Drive – Southern Embankment (K&L)

CITY OF BISMARCK

TYLER COULEE WATERSHED STUDY
PUBLIC INPUT MEETING DOCUMENTATION
FEBRUARY 5, 2004



Tyler Coulee – A watershed that presents diverse and complex storm water management issues for an urban environment.

Bismarck

Houston Engineering, Inc.

304 East Rosser Avenue
Suite 220
Bismarck, ND 58501
Ph. 701-323-0200
Fax 701-323-0300

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www.houstoneengineeringinc.com

Tyler Coulee Watershed Study
Public Input Meeting Documentation
February 5, 2004

Table of Contents

SIGN – IN FORMS/SPREADSHEET

Bismarck Tyler Coulee Study Public Meeting
Sign-In Form

First Name	Last Name	Address	City	State	Zip	E-mail
Kevin	Thomas	2628 Springfield Street	Bismarck	ND	58503	ihuff0071@bis.midco.net
Irwin	Huff	3823 Overlook Drive	Bismarck	ND	58503	
David	Schall	4212 Overland Road	Bismarck	ND	58503	
Errol	Erickson	1401 Territory Drive	Bismarck	ND	58503	
Karen	Wolf	1942 Mesquite Loop	Bismarck	ND	58503	
Bob	Rausch	1942 Mesquite Loop	Bismarck	ND	58503	
Carolyn	Frank	1926 Mesquite Loop	Bismarck	ND	58503	
Al	Dohrmann	501Huron Drive	Bismarck	ND	58503	
Harvey	Schneider	2548 Ithica Drive	Bismarck	ND	58503	
Charles	Lindsey	618 W. Interstate Ave.	Bismarck	ND	58503	
Lois	Vilella	1819 Santa Gertrudis Drive	Bismarck	ND	58503	
Bennett	Kubischta	1729 Santa Gertrudis Drive	Bismarck	ND	58503	
Scott	Hopfauf	2767 Springfield Street	Bismarck	ND	58503	
Ruth & Tom	Johnson	1415 Territory Drive	Bismarck	ND	58503-0171	roj@bis.midco.net
Jack	Marquart	987 W. Burleigh Ave.	Bismarck	ND	58504	
Paul	Maddord	1401 Canyon Drive	Bismarck	ND	58503	
DeAnn	Ament	626 Brunswick Circle	Bismarck	ND	58503	
Kathy	Fortney	618 W. Interstate Ave.	Bismarck	ND	58503	
John	Savageau	3747 Kingston Drive	Bismarck	ND	58503	mjjs@btinet.net
Tim	Klug	4420 Valley Drive	Bismarck	ND	58503	
Linda	Gerhardt	1902 N. Grandview	Bismarck	ND	58503	
Joe	Schulte	2636 Clydesdale Drive	Bismarck	ND	58503	
Jerome	Werlinger	709 Aspen Ave.	Bismarck	ND	58503	
Ken	Skuzn	3432 Overlook Drive	Bismarck	ND	58503	
Bill & Norma	Sandberg	1417 Territory Drive	Bismarck	ND	58503	
Keith	Demke	1830 N. 22nd Street	Bismarck	ND	58501	kdemke@state.nd.us
George	Gerhardt	1902 N. Grandview	Bismarck	ND	58503	
Dave	McCusker	2912 Remuda Drive	Bismarck	ND	58503	
Art	Roer	K & L Homes	Bismarck	ND	58501	
Bill	Gunnerson	811 Stagecoach Circle	Bismarck	ND	58503	
Bob	Entringer	1333 Territory Drive	Bismarck	ND	58503	
Steve	Neu	400 E. Front Ave.	Bismarck	ND	58504	
Robert	Pavel	3113 Daytona	Bismarck	ND	58503	
Lyle	Halvorson	1400 West Century	Bismarck	ND	58503	
David & Sharor	Dvorak	727 Mustang	Bismarck	ND	58503	
Curt	Walth	3040 Tyler Parkway	Bismarck	ND	58503	
Phil	Murdoff	4318 Overland Road	Bismarck	ND	58503	
Jason	Petryszyn	4829 Fountain Blue	Bismarck	ND	58503	
Doug	Mahowald	1410 N. Territory Drive	Bismarck	ND	58503	
Irene & Don	Jensen	3728 Kingston	Bismarck	ND	58503	

Bismarck Tyler Coulee Study Public Meeting
Sign-In Form

First Name	Last Name	Address	City	State	Zip	E-mail
Rodney	Hoff	1973 Mesquite Loop	Bismarck	ND	58503	
Steve	Smoley	500 Huron	Bismarck	ND	58503	
Gary	Beazley	2950 Domino Drive	Bismarck	ND	58503	
Stuart	Libby	3110 Ithica Drive	Bismarck	ND	58503	stulibbt@bis.midco.net
Mark	Bohrer	523 Sudbury Ave.	Bismarck	ND	58503	
Kirk	Mitzel	1636 Canyon Drive	Bismarck	ND	58503	
Kurt	Mosher	2801 River Road	Bismarck	ND	58503	kurt1827mo@aol.com
Lon	Romsaas	1301 Laramie Drive	Bismarck	ND	58503	
Tom	Weigel	1732 Golf Drive	Bismarck	ND	58503	
Rand	Strothman	2931 Tyler Parkway	Bismarck	ND	58503	strothmanl@prodigy.net
Rick	Koenocher	1400 Territory Drive	Bismarck	ND	58503	
Doug	Scheetz	901 Mustang	Bismarck	ND	58503	
Kevin G.	Nelson, PE	3831 Kingston Drive	Bismarck	ND	58503	
Chip & Anita	Thomas	700 Mustang Drive	Bismarck	ND	58503	athomas@ndita.org
John	Walstad	2506 Henry Street	Bismarck	ND	58503	
Mark	Krell	2004 Broadview Lane	Bismarck	ND	58503	
Ed	Murphy	508 Brunswick Drive	Bismarck	ND	58503	
Al	Frank	1801 Santa Gertrudis Drive	Bismarck	ND	58503	
Fay	Connell	1825 South Grandview Lane	Bismarck	ND	58503	
Terry	Ziegler	3029 Tyler Parkway	Bismarck	ND	58503	
Sterling	Kaubreer	618 Aspen	Bismarck	ND	58503	
Al	Wolf	1942 Mesquite Loop	Bismarck	ND	58503	
Cordel	Backman	512 Arabian Ave.	Bismarck	ND	58503	

Bismarck

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Irwin Huff	3823 Overlook Drive	Bismarck, ND	58503	ihuff0071@Bis.Midco
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Errol Erickson	1401 TERRITORY DRIVE	BISMARCK, ND	58503	
Karen Wolf	1942 Mesquite Loop	Bismarck ND	58503	
Bob Rakisch	1944 " "	"	"	
Carolyn Frank	1926 Mesquite Loop	Bismarck	58503	
Al Dohrmann	501 Huron Dr	Bismarck	58503	
Harvey Schneider	2548 Ithica Dr.	Bis.	58503	
Charles Fordney	618 - Woodlawn ave	Bis	58503	
Luis Vilella	1819 SANTA GERTRUDIS DR	BISMARCK, ND	58503	
Bennett Kubischta	1729 Santa Gertrudis DR	BISMARCK ND	58503	

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Scott Hopfauf	2767 SPRINGFIELD ST	BISMARCK	58503	
Ruth & Tom Johnson	1415 Territory Drive	Bismarck, ND	58503-0171	Rojebis.midco.net
Jack Marquart	987 W. Burleigh Ave	Bismarck ND	58504	
Paul Maddock	1401 Canyon Dr.	Bis	58503	
DeAnn Ament	626 Brunswick Circle	Bis	58503	
Kathy Fortney	618 W Interstate Ave	Bis	58503	
John Savageau	3747 Kingston Dr	BIS	58503	MJJS@BTINet.NET
Tim Klug	4420 Valley Dr	Bis ND	58503	
Linda Reinhardt	1902 N. Grandview	Bis	58503	
JOE Schutt	2636 CLYDESDALE DR	Bis	58503	
Jerome Werlinger	709 ASPEN Ave	BIS	58503	
Ken Skuza	3432 Overlook Av	Bis	58503	

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George Gerhardt	1902 N Grandview	Bismarck		
Dave McCusker	2912 Remuda Drive	Bismarck	58503	
Art Rock	KvL Homes	Bis	58501	
Bill Gunnerson	811 Stagecoach Circle	"	58503	
Bob Entringer	1333 Territory Dr	Bis	58503	
Steve Neu (BPRD)	400 E Front	Bismarck	58504	
Robert Pavel	3113 Daytona	Bismarck	58503	
Lyle Halvorson	1400 W. Century	Bis	58503	
David & Sharon Dvorak	727 Mustang	Bis	58503	

Bismarck

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NAME	ADDRESS	CITY, STATE	ZIP CODE	E-MAIL
Curt WALSH	3040 Tyler PKwy	BISMARCK	58503	
Phil Murdoff	4318 Overland Rd	Bis	58503	
JASON Petryszyn	4829 FOUNTAINBLUE	BIS		
Doug Mahowald	1410 N TERRITORY Dr	Bis	58503	
Irene & Don Jensen	3728 Kingston	Bis.	58503	
Rodney Hoff	1973 Mesquite Lp	Bis	58503	
Steve Smokey	500 Huron	Bis	58503	
Gary Beazley	2950 Domino Dr	Bis	58503	

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Stuart Libby	3110 Ithica Dr.	Bismarck, ND	58503	stulibby@bis.midco.net
Mark Bohrer	523 Sudbury Ave	Bis	58503	
Kirk Mitzel	1636 Canyon DR	Bis	58503	
KURT MOSHER	2801 River Road	Bis	58503	~~Kurt~~ Kurt1827mo@
Lon Romsaas	1301 LARAMIE DR	BIS	"	
Tom Weigel	1732 GOLF Dr	Bis	"	
Rand Strothman	2931 Tyler Pkwy	Bis	58503	STRothman L@prodigy.net

Bismarck

Tyler Coulee Watershed Study
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NAME	ADDRESS	CITY, STATE	ZIP CODE	E-MAIL
Rick Koenecke	1400 territory Dr.	Bismarck ND	58503	
Doug Scheetz	901 Mustang	Bis ND	58503	
KEVIN G. NELSON, P.E.	3831 KINGSTON DR.	BIS. ND	58503	
CHIP & ANITA THOMAS	700 MUSTANG DR	" "	58503	athomas@NDHA.org
John Walstad	2506 Henry St	Bis	58503	
Mark Krell	2004 Broadview Ln.	Bis. ND	58503	
ED MURPHY	508 BRUNSWICK DRIVE	" ND	58503	

Bismarck

Tyler Coulee Watershed Study
Public Meeting

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NAME	ADDRESS	CITY, STATE	ZIP CODE	E-MAIL
Al Frank	1801 Santa Gertrudis Dr	Bis, ND	58503	
Jay Connell	1825 S. Grandview Lane	" "	"	
Tony Ziegler	3029 Tyler Pkwy	"	"	
Sterling & Kay Breuer	618 Aspen	"	"	
Al Wolf	1949 Mesquite Loop	Bis	58503	

COMMENT SHEETS

Tyler Coulee Study
Comment Sheet

Summary of comments:

Who is to pay and what will the future home owners be responsible for?

Some property owners feel they have already paid for watershed requirements.

Request to the City to come prepared with a detailed plan on assessments.

Concerns of higher taxes of assessments but better than unplanned development.

Request for more information on how residents households will be assessed.

Why aren't developers being assessed as this is where the problems begins.

One of the presenters said that of the 1990 acre watershed only about 300 acres are within the city.

People are willing to pay their fair share but will resist when cost not equally assessed.

Annex the entire watershed into the city. The piecemeal has been the pattern of the C-Family trust does not lend itself to good & uniform assessment of costs for improvements.

Have the city act jointly with the Burleigh Cty Wtr Board. During the 1997 debate we were told if the Wtr Board got involved then the cost could be spread over the entire watershed.

Pursue FEMA monies or other grants for this project.

Why save Pioneer Park? It flooded long before there was development. The City needs to control the developments & the destruction of the land & the natural greenways. May want to consider Pioneer Park expendable if future heavy rains continue to cause flooding & damage.

There seems to be the concept that before development, high water flow never occurred, erosion was nonexistent, that channel merely gradual slopes, and that Pioneer Park was always high-and-dry. None of these are in fact true.

Continue to leave as much natural grassland & nature as possible when developing this area.

Wildfires - potential for catastrophic fires caused by fuels I the coulee (i.e., grass, strong winds). Plan should have wildfire control component.

The ND Forest Service (Mike Santucci) should be consulted as well as the Bismarck Fire Department.

Water Quality of the runoff should be looked at (i.e., T55, Hwy, etc.) Bismarck should require each developer to contain/manage stormwater from the land they are developing before the developer can sell any land. The developer should not be responsible for "run-on" to their development. The study should identify problem area's where run-on will be a concern.

Belief that with good planning and including all the land development involved equally in cost sharing, that this project can be completed & that all will benefit.

What are the results of the petitions that were submitted 7 yrs ago? Not addressed at this mtg. When questioned Mark Deutschman was not even aware of this. No group discussion before being asked to join one of the four discussion groups. Majority of people want the question of Who is going to pay for this answered before sharing ideas of the esthetics, trails, green spaces, etc.

Poor demonstration by the City and Houston not supplying the full knowledge of this project. Not understood how this project has gotten this far without proper planning. Outcry from property owners will bring about a petition to stop this project.

Bismarck

HE

Comment Sheet

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2/6/04

Al Frank 1801 Santa Gertrudis Dr. Bismarck, ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

I believe the city is taking the correct approach is developing a plan for the Tyler watershed. I was involved in the 1997 petition drive that questioned the plan the city had for paying for the project at that time. The following are my observations and suggestion on the current effort:

1. There were lots of unhappy people at the meeting, mainly because the issues that stopped the project in 1997 had not been addresses. That issue being who would pay. Most know if the city goes alone in this project then only that land within the city will be assessed the cost. One of the presenters at the meeting told me that of the 1900 acre watershed only about 300 acres are within the city. People are willing to pay their fair share, but will resist when the cost are not equally assessed.

2. I feel that the project would be acceptable to most if the cost is equally assessed. So how to do that is the big question. One way would be to annex the entire watershed into the city. The piecemeal annexation that has been the pattern of the C-Family trust does not lend itself to good planning and uniform assessment of costs for improvements. The second way to tackle this issue is to have the city act jointly with the Burleigh County water Board. During the 1997 debate I was told that if the Water Board got involved then the cost could be spread over the entire watershed.

3. I accept the fact that residential development has accelerated water flow and subsequent problems, some area of the watershed more that others. However, there seems to be the concept that before development, high water flow never occurred, erosion was nonexistent, that channel banks were merely gradual slopes, and that Pioneer Park was always high-and-dry. None of these are in fact true. The diversion of water by the highway department in the early 1960's into the basin off the south-end of Tyler Parkway and the straighten of the channel carrying that water to the river, often through Pioneer Park, is also a condition that was not caused by residential development.

4. I believe that with good planning and including all the land involved equally in cost sharing, that this project can be completed and that all will benefit.

> *Continue on the back or attach additional sheets*

See back for easier reading →

The Tyler Coulee Watershed Study is sponsored by the City of Bismarck. Questions or comments? Contact the City of Bismarck Project Manager, Lisa Ansley at (701) 222-6580. You may also contact Houston Engineering, Inc. Project Manager, Michael H. Gunsch at (701) 323-0200.

Al Frank 1801 Santa Gertrudis Dr. Bismarck, ND 58503

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HOUSTON ENGINEERING
BISMARCK, ND

Bismarck

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Name	Address	City	State	Zip
Phil Murdoff	4318 Overland Rd	Bismarck	ND	58503

Comments, Ideas, & Concerns

Thank you for your presentation and the opportunity to comment on the Tyler Coulee Watershed Study. I have the following comments concerning the study...

- The design of any stormwater runoff system needs to be done without creating standing water that will become breeding grounds for mosquitoes + West Nile virus.

- There needs to be more control of the development within the watershed. Larger parks + greenspaces should be considered to mitigate the effects of development on storm water runoff.

- I question the location of Pioneer Park. Pioneer Park has had a problem with flooding long before development occurred in the Tyler Coulee watershed. Thus, although current + future development within the watershed may contribute to flooding in Pioneer Park with or without storm water runoff control, they are not the sole cause + should not be held fully responsible.

- The development of recreation trails (don't necessarily have to be paved) along buffer areas adjacent to coulees/waterways is a good idea and should be pursued.

> Continue on the back or attach additional sheets

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Name Ruth Owens Johnson address 1415 Territory Drive City Bismarck State ND 58503-0171

Comments, Ideas, & Concerns

What are the results of the petitions that were submitted seven years ago? This was NOT addressed in the Public Meeting on the Tyler Coulee Storm Water Management Study meeting that was held Thursday, February 5, 2004. When questioned later, the presenter Mark Deutschman was not even aware of this.

There was a short informative meeting with NO group discussion before being asked to join one of the four discussion groups. There also was no secretary recording the comments, just the Comment Sheet that one has to make the effort to fill out and sign also.

The consensus of the one breakout discussion group that Mark headed was the bottom line of WHO WAS GOING TO PAY FOR THIS? It seems that the majority of the people want this question answered <u>before</u> sharing ideas of the esthetics, trails, green space and so on.

Lisa Ansley, whom I visited with before the meeting started, told me that the city cannot assess undeveloped land. It appears that the watershed area outlined in the map has the majority of the land undeveloped. Why wasn't the county represented if they would be the ones to assess the large chunks of undeveloped land?

One of the men in the group also brought up the history of having State and Federal involvement because when Interstate 94 was built, the cheaper solution of storm water was used to divert water that naturally flowed south to flow to the northwest. Where were they?

People in the watershed area that already have homes there have been assessed storm sewer fees and the system is working fine. If there is more development, let those who add to the storm water volume pay for that privilege and not the ones "downstream"!

I'm sure that there are more issues involved, but the main issue remains, WHO IS GOING TO PAY FOR THIS????

Ruth Owens Johnson

> Continue on the back or attach additional sheets

The Tyler Coulee Watershed Study is sponsored by the City of Bismarck. Questions or comments? Contact the City of Bismarck Project Manager, Lisa Ansley at (701) 222-6580. You may also contact Houston Engineering, Inc. Project Manager, Michael H. Gunsch at (701) 323-0200.

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PROPERTY OWNER OF NW BISMARCK

Name Address City State Zip

Comments, Ideas, & Concerns

POOR DEMONSTRATION BY THE CITY + HOUSTON NOT SUPPLYING THE FULL KNOWLEDGE OF THIS PROJECT.

OUTCRY FROM PROPERTY OWNERS WILL BRING ABOUT A PETISION TO STOP THIS PROJECT.

IT IS NOT UNDERSTOOD HOW THE PROJECT HAS GOTTEN THIS FAR WITHOUT PROPER PLANNING.

> Continue on the back or attach additional sheets

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Bismarck

HE

Comment Sheet

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Name	Address	City	State	Zip
Rodney Hoff	1973 Mesquite Lp	Bismarck	ND	58503

Comments, Ideas, & Concerns Tyler Coulee Watershed

Practices and facilities – I have completed the general survey, but have nothing more specific to add here, at least not yet. I just moved into the area. I'm not familiar with the physical aspects of this.

Costs – I got the definite impression at the 2-5-04 meeting that this is important to my neighbors.
I believe there should be enough money to do this job right. A lot of people live within this watershed, and there will be many more. I favor doing a very good job of runoff control, while retaining fiscal responsibility at about the current level in Bismarck.
I believe the undeveloped areas must pay their fair share of this. Their fair share should take into account the time value of money, when compared to those of us who will pay up-front. I think the developers will find the funds.
I would appreciate it if these cost comments were shared with policy-makers as well as engineers.

Thank you.

> Continue on the back or attach additional sheets

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Name	Address	City	State	Zip
Dvoraks	727 Mustang Dr.	Bismarck	ND.	58503

Comments, Ideas, & Concerns

MORE INFORMATION ON HOW RESIDENTS HOUSEHOLDS WILL BE ASSESSED.

WHY AREN'T DEVELOPERS BEING ASSESSED AS THIS IS WHERE THE problem BEGINS.

> Continue on the back or attach additional sheets

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Kevin Thomas 2628 Springfield ST. Bismarck ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

I would hope the city would come to the next meeting with a detailed plan on assessments.

> Continue on the back or attach additional sheets

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Irwin Huff 3823 Overlook Dr. Bismarck ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

No comments.
No good ideas.
Concerns of higher taxes & assessments, but might be better ~~than~~ than unplanned developement.

> Continue on the back or attach additional sheets

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Name Address City State Zip

Comments, Ideas, & Concerns

Very poor presentation

> *Continue on the back or attach additional sheets*

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Stuart Libby 3110 Ithica Dr Bismarck, ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

I'm concerned that established property owners will be required to finance or subsidize the contractors and future property owners. We have already paid for our Watershed requirements.

> *Continue on the back or attach additional sheets*

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John Savageau 3747 Kingston Dr Bismarck ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

Why does the city continue to spend its resources trying to save Pioneer Park. the Park ~~has~~ flooded Long before there was development.

The City needs to control the developments and the destruction of the land and the natural greenways.

> *Continue on the back or attach additional sheets*

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Robert Pavel 3113 Daytona Dr Bismarck ND 58503

Name Address City State Zip

Comments, Ideas, & Concerns

pursue FEMA monies (or other available Grants) for this project –

Continue to leave as much natural grassland & nature as possible when developing this area –

May want to consider all or part of Pioneer Park as "expendable" if future heavy rains continue to cause flooding & damage.

> Continue on the back or attach additional sheets

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Bennett R Kubischta 1729 Santa Gertrudis Dr

Name Address City State Zip

work 701-328-3555 Home 701-258-5012 Bismarck ND 58503

Comments, Ideas, & Concerns

WILDFIRES:

These coulees ~~are~~ have the potential for catastrophic wildfires. This would be from the fuels in the coulee (e.g. grass), & strong winds.

I believe that this plan should have a wildfire control component.

The ND Forest Service (Mike Santucci) should be consulted as well as the Bismarck Fire Department.

> Continue on the back or attach additional sheets

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Doug Scheetz 901 Mustang Drive Bismarck ND 58554

Name Address City State Zip

Comments, Ideas, & Concerns

- During the course of the study water quality of the runoff should be looked at. example: TSS, NH_4, etc.

- Bismarck should require each developer to contain/manage ~~of~~ storm water from the land they are developing before the developer can sell any land. ~~I realize this ma might not~~ The developer should not be responsible for "run-on" to their development. ~~so the affected storm water district should~~ The study should identify problem area's where run-on will be a concern.

> Continue on the back or attach additional sheets

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EVAULATION FORMS

Tyler Coulee Study
Evaluation Form

		SA Strongly Agree	A=Agree	U=Undecided	D=Disagree	SD Strongly Disagree	Totals
Question #1. I understand the goals of the public information meeting.							
		3	8	3	1	0	15
	Percent	20%	53%	20%	7%	0%	
Question #2. The introductory presentation was valuable in helping me understand the study							
		3	6	2	4	0	15
	Percent	20%	40%	13%	27%	0%	
Question #3. I was comfortable sharing my thoughts and ideas about the study.							
		3	5	5	2	0	15
	Percent	20%	33%	33%	13%	0%	
Question #4. I had an opportunity to learn about the ideas and opinions of others.							
		3	8	1	3	0	15
	Percent	20%	53%	7%	20%	0%	
Question #5. Everyone had an opportunity to speak and share ideas.							
		2	6	2	3	1	14
	Percent	13%	40%	13%	20%	7%	
	Total	14	33	13	13	1	74
Overall	Percent	19%	45%	18%	18%	7%	

Question # 6. What did you like least about the meeting?

No questions/answer period - questions before the entire attendance was denied. (2)
Nothing (1)
Location (1)
Lack of info/ambiguous (2)
No group discussion - broken into 4 groups and no one recording comments. Main question not answered - who is going to pay for this? (3)
Poor, no specifics on project design, reasons, cost. (1)
City is moving to fast in finalizing the Master Plan (1)
No mention made about what types of changes might be made in the "drainage ditch" (1)
Presentors didn't address current/future storm water runoff problems as mentioned in the flyer. (1)
(6) Reponses did not answer -

Question #7. What did you like most about the meeting?

The presenters tried their best, but did not have any idea of the history from 1997, cost, etc. (1)
Location (1)
Hearing comments and concerns of other people living further "up" the coulee from Mesquite Lane (1)
To see the beginning of a large outcry against this project (1)
An opportunity to see and input into Bismarck development plans (1)
Very good presentation - material & well -organized (1)
Presentation tried their best but did not have any idea of the history from 1997, cost, etc. (1)
Thougt public did a great job voicing their opinion/learned about the people/area moved into (2)
(6) responses did not answer

Question #8. How did you learn about this meeting?

14 - mailing/flyer
1 - TV & Bismarck Tribune
1 - no answer given

Bismarck

HE

Evaluation Form

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PLEASE RATE THE FOLLOWING STATEMENTS USING THE SCALE BELOW

SA = Strongly Agree **A** = Agree **U** = Undecided **D** = Disagree **SD** = Strongly Disagree

1. I understood the goals of the public information meeting.

☐ SA ☐ A ■ U ☐ D ☐ SD

2. The introductory presentation was valuable in helping me understand the study objectives.

☐ SA ☐ A ■ U ☐ D ☐ SD

3. I was comfortable sharing my thoughts and ideas about the study.

☐ SA ☐ A ■ U ☐ D ☐ SD

4. I had an opportunity to learn about the ideas and opinions of others.

☐ SA ■ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting? Not able to come to a group consensus because the main group was broken up into four smaller groups.
There was No Group discussion and No one Recording the comments.
The main question was Not Answered, Who is going to pay for this!

7. What did you like most about the meeting?

Location

8. How did you learn about this meeting?

Mail

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5. Everyone had an opportunity to speak and share ideas.

   ☐ SA ☒ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

   No mention was made about what exact types of changes might be made in the "drainage ditch".

7. What did you like most about the meeting?

   Hearing the comments & concerns of other people living further "up" the coulee from Mesquite V.

8. How did you learn about this meeting?

   Letter from engineering Dept.

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☐ SA ☒ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☒ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

7. What did you like most about the meeting?

8. How did you learn about this meeting?

Mail.

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☐ SA ☐ A ☐ U ☑ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☐ U ☑ D ☐ SD

6. What did you like least about the meeting?

Lack of info.

7. What did you like most about the meeting?

8. How did you learn about this meeting?

mailing

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☐ SA ☒ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☐ U ☒ D ☐ SD

6. What did you like least about the meeting?

nothing

7. What did you like most about the meeting?

Just an opportunity to see and input into Bismarck development plans

8. How did you learn about this meeting?

TV and Bismarck Tribune

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6. What did you like least about the meeting?

7. What did you like most about the meeting?

8. How did you learn about this meeting?

PERSONAL MAILING (FLYER)

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4. I had an opportunity to learn about the ideas and opinions of others.

☐ SA ☒ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☒ U ☐ D ☐ SD

6. What did you like least about the meeting?

Rather Ambiguous

7. What did you like most about the meeting?

—

8. How did you learn about this meeting?

Letter - mail

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☒ SA ☐ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☒ SA ☐ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

It appears the city is moving too fast in finalizing the master plan

7. What did you like most about the meeting?

I thought the public did a great job voicing their opinion

8. How did you learn about this meeting?

Letter

Bismarck

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☐ SA ☒ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☒ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

The presentation did not address current/future storm water runoff problems as mentioned in the flyer received in the mail

7. What did you like most about the meeting?

Learned something about the area I've moved into met people that live in the area.

8. How did you learn about this meeting?

Via Mail (Flyer).

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Bismarck

Bennett Kubischta

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☐ SA ☐ A ☐ U ☒ D ☐ SD

6. What did you like least about the meeting?

7. What did you like most about the meeting?

8. How did you learn about this meeting?

Bismarck

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☒ SA ☐ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☒ SA ☐ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

7. What did you like most about the meeting?

8. How did you learn about this meeting?

Mailing

Bismarck

Evaluation Form

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☐ SA ☒ A ☐ U ☐ D ☐ SD

2. The introductory presentation was valuable in helping me understand the study objectives.

☐ SA ☒ A ☐ U ☐ D ☐ SD

3. I was comfortable sharing my thoughts and ideas about the study.

☐ SA ☒ A ☐ U ☐ D ☐ SD

4. I had an opportunity to learn about the ideas and opinions of others.

☐ SA ☐ A ☐ U ☒ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☒ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

- There was no opportunity to hear concerns/suggestions from all of the attenders. The formal presentation should have included a open question - answer period.

7. What did you like most about the meeting?

Very good ~~presentation~~ material & well organized

8. How did you learn about this meeting?

city mailing

The Tyler Coulee Watershed Study is sponsored by the City of Bismarck. Questions or comments? Contact the City of Bismarck Project Manager, Lisa Ansley at (701) 222-6580. You may also contact Houston Engineering, Inc. Project Manager, Michael H. Gunsch at (701) 323-0200.

Bismarck

HE

Evaluation Form

Please fill out this form and return it at the end of the meeting.

PLEASE RATE THE FOLLOWING STATEMENTS USING THE SCALE BELOW

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☐ SA ☒ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

7. What did you like most about the meeting?

8. How did you learn about this meeting?

By LETTER

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☐ SA ☐ A ☐ U ☒ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☐ U ☐ D ☒ SD

6. What did you like least about the meeting?

There was no general question and answer allowed. Question before the entire attendance was denied.

7. What did you like most about the meeting?

The presenters tried their best, but did not have any idea of the history from 1997, cost, etc.

8. How did you learn about this meeting?

mailing

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☐ SA ☐ A ☐ U ☐ D ☐ SD

5. Everyone had an opportunity to speak and share ideas.

☐ SA ☐ A ☐ U ☐ D ☐ SD

6. What did you like least about the meeting?

POOR, NO SPECIFICS ON PROJECT DESIGN, REASONS, COST

7. What did you like most about the meeting?

TO SEE THE BEGINNING OF A LARGE OUTCRY AGAINST THIS PROJECT

8. How did you learn about this meeting?

FLYER

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Bismarck

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☐ SA ☒ A ☐ U ☐ D ☐ SD

recorded 2/17/04

3. I was comfortable sharing my thoughts and ideas about the study.

☐ SA ☐ A ☒ U ☐ D ☐ SD

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7. What did you like most about the meeting?

8. How did you learn about this meeting?

Mail annoucement

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SURVEY FORMS/CHARTS

Tyler Coulee Study
Survey Form

Question # 1. Existing & Potential SWM Issues

Water Quality - nutrient loading - minimize it.

Future need? - as development continues will this effort be sufficient.

Address legal history of Tyler Coulee.

Preventing destruction of natural area that hold water back.

Consider a moratorium on all development until entire watershed is annexed into the city.

Require more green space.

Keep permanent water storage to a minimum.

Who is going to pay? Don't build or push dirt intot he coulee. Build back away from the edges.

In the Mesquite Village neighborhood every effort should be made to preserve wildlife.

When, where & who was invited to the "initial" discussions to proceed with project after last failure.

Public safety (prevention of mosquito breeding grounds & in turn West Nile virus).

Question # 2. Additional Issues & Problems

Mosquitoes - wildlife control - safety (kids & standing water) - maintenance - grass mowing - beautification.

Developers are destroying the land or the sake of an additional lot.

Consider doing another evaluation of the containment area between Overland Rd & Valley Dr. concerned about stormwater pooling & not draining fasr enough to prevent damage to property

Horizon School created many problems - native grasses not planted nor maintained - hay bales abandoned - ditch mowing has destroyed any cover established in the poor soils.

All parties must be fully involved so that cost can be equally and uniformly spread over entire watershed, not just city property owners.

No surface rod should be distrubed & no reshaping of the coulee by heavy equipment should be allowed Unless absolutely necessary.

No standing water should be allowed (West Niles) - also lot size should require min 200' set back from steep terraine.

Question # 3 An efficient and safe SWMS is attainable using variety of practices

	Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant	Totals
Parks/Greenspace	**9**	**5**	**2**		**1**	**17**
Percent	**53%**	**29%**	**12%**	**0%**	**6%**	
Trails	**5**	**6**	**3**	**0**	**3**	**17**
Percent	**29%**	**35%**	**18%**	**0%**	**18%**	
Buffer areas adjacent coulee/waterway	**8**	**5**	**2**	**2**	**0**	**17**
Percent	**47%**	**29%**	**12%**	**12%**	**0**	
Preserving aesthetically pleasing areas	**8**	**6**	**3**	**0**	**0**	**17**
Percent	**47%**	**35%**	**18%**	**0**	**0**	
Totals	**30**	**22**	**10**	**2**	**4**	**68**
Percent	**44%**	**32%**	**15%**	**3%**	**6%**	

Tyler Coulee Study
Survey Form

Question # 4 Additional cost may or may not be associated - your willingness to pay

	Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant	Totals
Parks/Greenspace	**5**	**7**	**1**	**0**	**1**	**14**
Percent	**36%**	**50%**	**7%**	**0%**	**7%**	
Trails	**3**	**5**	**4**		**3**	**15**
Percent	**20%**	**33%**	**27%**	**0%**	**20%**	
Buffer areas adjacent coulee/waterway	**3**	**9**	**2**	**1**	**1**	**16**
Percent	**19%**	**56%**	**13%**	**6%**	**6%**	
Preserving aesthetically pleasing areas	**6**	**5**	**3**	**1**	**1**	**16**
Percent	**38%**	**31%**	**19%**	**6%**	**6%**	
Totals	**17**	**26**	**10**	**2**	**6**	**61**
Percent	**28%**	**43%**	**17%**	**3%**	**10%**	

Question # 5 Provide additional comments to be considered.

Various City officials (Steve Neu) promised action and funding on many of the items this study appears to look for - no action took place & it doesn't look like the funding will either.

How will the costs be shared with future home owners.

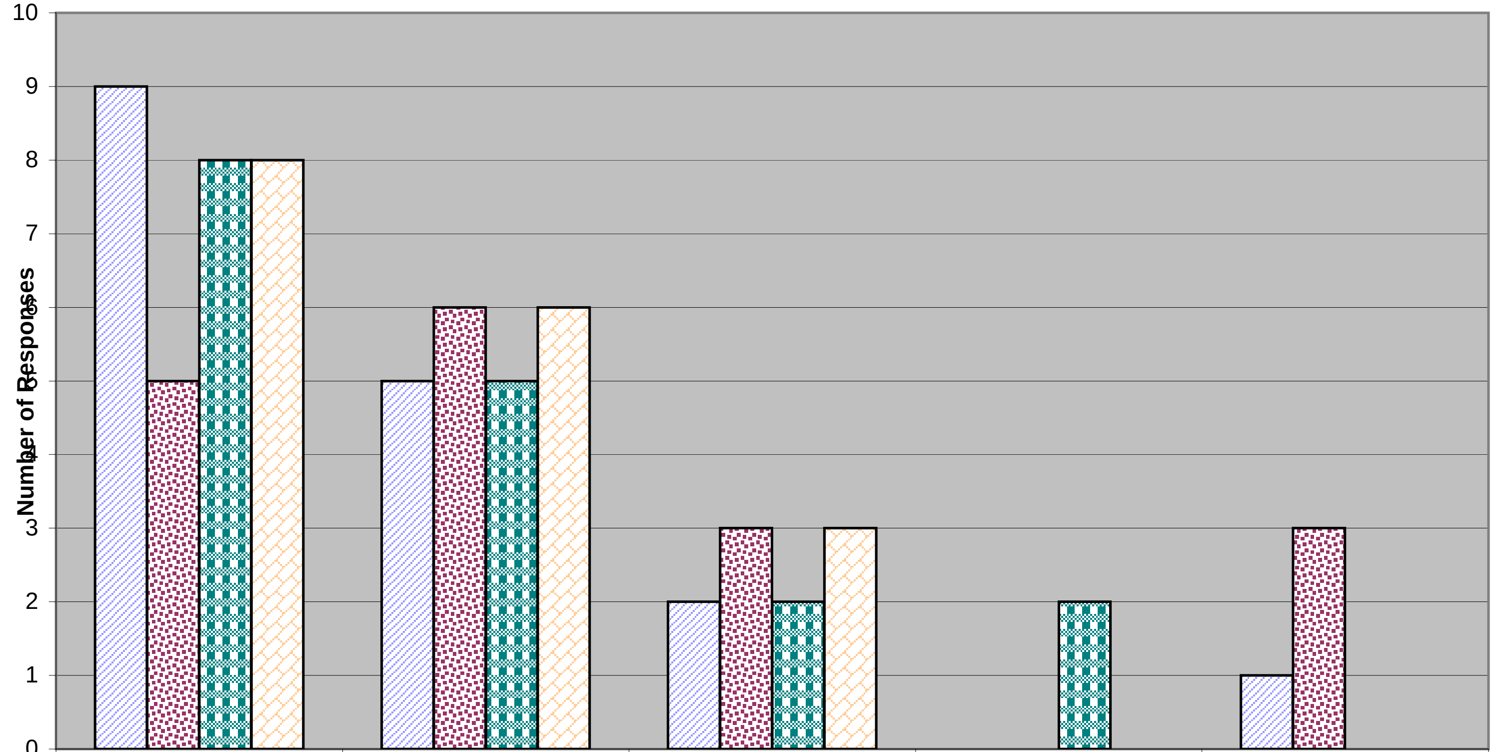
Bismarck should follow other municipalities that require land developers to pay for and develop/install storm water containment.

These improvements benefit the developers as these improvements will help sell lots, thus the cost should be placed directly on the developers.

The drainage "ditch" is only about 35 yds. WNW of my lot and have never seen the water level 4' above where it is normally. No danger of of any pverflow here.

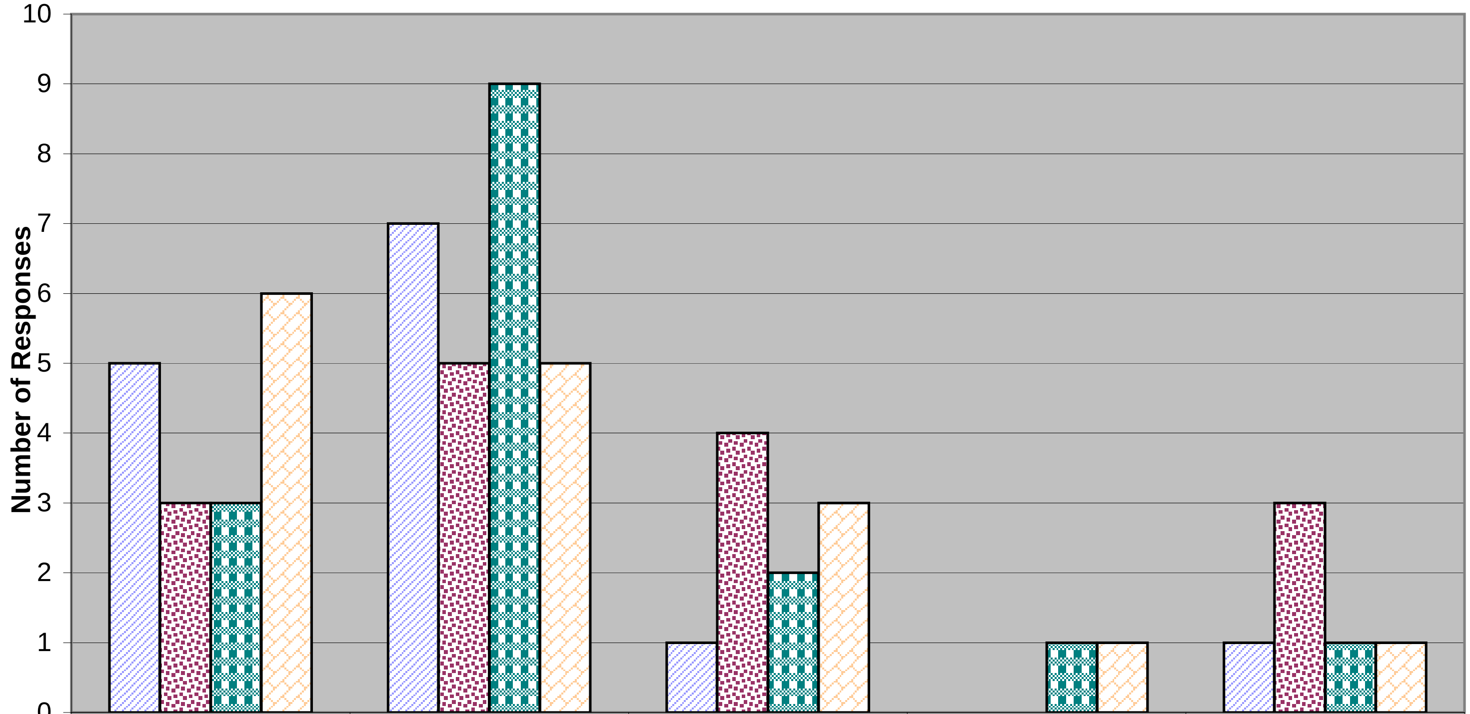
It appears that much planning has been completed and this entire escapade is merely a token for property owners to feel like we are involved in the plans. Again we see the rojan horse & will require property owners to unite & defeat this project.

Please identify the relative importance of including the following in the final storm water management solution for Tyler Coulee.



	Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
Parks/Greenspace	9	5	2		1
Trails	5	6	3	0	3
Buffer areas adjacent coulee/waterway	8	5	2	2	0
Preserving aesthetically pleasing areas	8	6	3	0	0

Please express your willingness to pay for these additional features, assuming the cost it "reasonable" and "affordabale."



	Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
Parks/Greenspace	5	7	1	0	1
Trails	3	5	4		3
Buffer areas adjacent coulee/waterway	3	9	2	1	1
Preserving aesthetically pleasing areas	6	5	3	1	1

Tyler Coulee Watershed Survey

The City of Bismarck has embarked upon a new study to identify the best methods and alternative for managing storm water runoff within the Tyler Coulee Watershed. Part of the public involvement process is obtaining feedback regarding the extent and severity of problems within the watershed. Please complete this questionnaire to assist the City with this study.

1. Existing and Potential Storm Water Management Issue

The City has developed a preliminary list of the criteria that will be used to design the practices necessary to manage storm water within the Tyler Coulee Watershed. These criteria are (not in priority order):

- Protect stream channels from erosion
- Avoid areas with excessively steep slopes
- Safely convey runoff through Pioneer Park
- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

Public safety (prevention of mosquito breeding grounds and in turn West Nile virus)

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

4. **Additional cost may or may not be associated with providing these features and practices. Please express your willingness to pay for these additional features, assuming the cost is "*reasonable*" and "*affordable.* "**

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☒	☐	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

____

____

____

____

____

____

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HOUSTON ENGINEERING
BISMARCK ND

Thank you for your Input. Please mail this feedback form to:

Michael Gunsch, Project Manager
Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, ND 58501-4012

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- Safely manage floodplains
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- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

WHEN, WHERE & WHO WAS INVITED TO THE "INITIAL" DISCUSSIONS TO PROCEED WITH THIS PROJECT AFTER THE LAST FAILURE.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

GIVEN THE RECENT WEST NILE PROBLEMS NO STANDING WATER SHOULD BE ALLOWED. ALSO LOT SIZE SHOULD REQUIRE MIN 200' SET BACK FROM ANY STEEP TERRAINE

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

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☒	☐	☐	☐	☐

200' SET BACK PARK BOARD TO SPEND MORE MONEY

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☒ WASTE OF MONEY

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

200' SET BACK

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

4. **Additional cost may or may not be associated with providing these features and practices. Please express your willingness to pay for these additional features, assuming the cost is "*reasonable*" and "*affordable.*"**

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☒

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

200' SETBACK LARGER LOTS

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

IT APPEARS MUCH PLANNING HAS BEEN COMPLETED AND THIS ENTIRE ESCAPADE IS MERELY A TOKEN FOR PROPERTY OWNERS TO FEEL LIKE WE ARE INVOLVED IN THE PLANS. AGAIN WE SEE THE TROJAN HORSE AND WILL REQUIRE PROPERTY OWNERS TO UNITE AND DEFEAT THIS PROJECT.

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BISMARCK, ND

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- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

• Water Quality - nuetrient loading - minimize it

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

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☐	☒	☐	☐	☐

Trails

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☐	☒	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

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Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
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Trails

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☐	☒	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

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☐	☐	☒	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

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☐	☐	☐	☒	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

• Bismarck should follow other municipalities that require land developers to pay for and develop/install storm water containment.

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- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

The legal history of the watershed from Tyler Coulee needs to be addressed.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

Horizon Middle School created many problems. native Grass has not been planted and maintained on the school property. Road construction (43rd) Stormwater mitigation (Hay bales) were put in place and abandoned (not maintained). The Bismarck Health Department has required ditch mowing which has destroyed any cover established in the poor soils. ect... ect...

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

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Trails — Get tax money from ~~Dorgan's~~ Sen. Conrad's Lewis+Clark trail fund.

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
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Parks / Green Space → The Park+Rec. Department promised this funding when the Horizon School land swap occured.

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Trails → Same as above

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

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Do you feel the City should consider additional criteria? If so, please describe the criteria below:

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

Consider doing another evaluation of the Containment Area between Overland Road & Valley Drive. Am concerned about Storm water pooling & not draining fast enough to prevent damage to my property.

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Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☒	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
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Parks / Green Space

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☐	☒	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
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Don't want a trail in my back yard

Buffer areas adjacent to the coulee / waterway

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Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, ND 58501-4012

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BISMARCK, ND

Tyler Coulee Watershed Survey

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- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

Preventing destruction of natural areas that hold back water.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

Developers are destroying the Land for the sake of an additional Lot

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

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At what Cost!!

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Becky Jones Mahlum said she would pay for my part.

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1) Invite Co. Water Board for formal involvement.

2) Capitalize on the 9:1 deal with Clairmont

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Do you feel the City should consider additional criteria? If so, please describe the criteria below:

FUTURE Need

As development continues will this effort be sufficient

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

Mosquitos — Maintenance

Grass mowing

Wild life control — Beautification

Safety (Kids & standing water)

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How will the costs be shared with future home owners — those who will build homes in the coming years

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Bennett Kubischta

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Do you feel the City should consider additional criteria? If so, please describe the criteria below:

- consider a ~~[illegible]~~ moratorium on all developments until entire watershed is annexed into city.
- Require more greenspace
- Keep permanent water storage to a minimum.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

All parties must be fully involved so that cost can be equally and uniformly spread over entire watershed, not just city property owners.

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

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Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

these improvements benefit the developers as these improvements will help sell lots, then the cost should be placed directly on the developers.

Thank you for your Input. Please mail this feedback form to:

Michael Gunsch, Project Manager
Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, ND 58501-4012

Tyler Coulee Watershed Survey

The City of Bismarck has embarked upon a new study to identify the best methods and alternative for managing storm water runoff within the Tyler Coulee Watershed. Part of the public involvement process is obtaining feedback regarding the extent and severity of problems within the watershed. Please complete this questionnaire to assist the City with this study.

1. Existing and Potential Storm Water Management Issue

The City has developed a preliminary list of the criteria that will be used to design the practices necessary to manage storm water within the Tyler Coulee Watershed. These criteria are (not in priority order):

- Protect stream channels from erosion
- Avoid areas with excessively steep slopes
- Safely convey runoff through Pioneer Park
- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

____

____

____

____

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

____

____

____

____

____

____

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Trails

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☒	☐	☐	☐	☐

4. **Additional cost may or may not be associated with providing these features and practices. Please express your willingness to pay for these additional features, assuming the cost is *"reasonable"* and *"affordable."*** I have a separate comment addressing my concern that the cost also be fairly allocated.

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Trails

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- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

Yes, Who is going to pay? In reference to Pioneer Park, historically that has been a Natural waterway that has been changed by the Parks & Recreation Development! Don't build or push dirt into the coulees. Build back away from the edges.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

Again, depends on who pays.

Parks / Green Space

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☐	☒	☐	☐	☐

Trails

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☐	☒	☐	☐	☐

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Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

4. Additional cost may or may not be associated with providing these features and practices. Please express your willingness to pay for these additional features, assuming the cost is *"reasonable"* and *"affordable."*

to Whom?

Parks / Green Space

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

Above - comments & Comment sheet.

Thank you for your input. Please mail this feedback form to:

Michael Gunsch, Project Manager
Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, ND 58501-4012

Robert Rausch
1944 Mesquite Loop
Bismarck ND 58503

Tyler Coulee Watershed Survey

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- Avoid areas with excessively steep slopes
- Safely convey runoff through Pioneer Park
- Safely manage floodplains
- Prevent public and private property damage
- Cost for implementation
- Water quality (minimize sediment in the water)

Do you feel the City should consider additional criteria? If so, please describe the criteria below:

In the Mesquite Village neighborhood every effort should be made to preserve presently existing wild-life cover along the drainage "ditch". Pheasants, Ducks, rabbits & Deer use it regularly! So far, we see them all the time.

2. Additional Issues and Problems

Please identify any issues or problems related to storm water management within the watershed that you feel could be reasonably included in this study.

No surface sod should be disturbed & no reshaping of the coulee by heavy equipment should be allowed unless absolutely necessary

3. An efficient and safe storm water management system for the Tyler Coulee Watershed is attainable using a variety of practices and facilities. Some of these practices and facilities are only indirectly related to controlling the rate and volume of runoff. Please identify the relative importance of including the following in the final storm water management solution for the Tyler Coulee Watershed.

Parks / Green Space in Mesquite Village area

N/A

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☒	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☒

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☒ in our area	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees) especially from Mesquite V. all the way to the Missou[ri]

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

4. **Additional cost may or may not be associated with providing these features and practices. Please express your willingness to pay for these additional features, assuming the cost is *"reasonable"* and *"affordable.* "**

Parks / Green Space

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☐	☒	☐	☐	☐

Trails

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☐	☐	☐	☒

Buffer areas adjacent to the coulee / waterway

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☐	☒	☐	☐	☐

Preserving aesthetically pleasing areas (e.g., mature trees)

Very Important	Moderately Important	Not Important	Moderately Unimportant	Very Unimportant
☒	☐	☐	☐	☐

5. **Please provide any additional comments you would like considered during the completion of this study.**

The drainage "ditch" is only about 35 yds. WNW of the rear of my lot. The slope down to it is about 45°. For 3½ yrs. I have never seen the water level more than about 4' above where it is normally. We are never in danger of any overflow here.

Bob Rausch
1944 Mesquite Loop

Thank you for your Input. Please mail this feedback form to:

Michael Gunsch, Project Manager
Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, ND 58501-4012

Tyler Coulee Watershed Master Plan

Welcome!

We heard your concerns

- Distribution of costs
  - Multiple assessments - current equalization process
  - A process for spreading costs to land outside the city limits
- What will the regional facilities cost me?
  - Estimated total costs & estimated cost per sq ft
- Development of marginal land
  - Development control line

Tyler Coulee Watershed Master Plan

- Progress of the two work groups
  - Master plan recommendations
    - Facilities for existing & future storm water demands
    - Cost estimates of the master plan improvements
  - Finance plan preliminary recommendations
    - Equitable distribution of costs
    - Alternatives to assess properties outside city limits

Tyler Coulee Watershed Master Plan

Meeting Dates

- **Master Plan Work Group**
  - May 27, 2004
  - July 8, 2004
  - August 5, 2004
  - September 16, 2004
  - November 1, 2004
- **Finance Work Group**
  - May 12, 2004
  - June 2, 2004
  - June 29, 2004
  - August 2, 2004
  - August 30, 2004
  - November 1, 2004

Tyler Coulee Watershed Master Plan

Meeting Participants

- Craig Bleth
- David Bliss
- Mark Bohrer
- Fay Connell
- Gene Duchsherer
- Brian Eiseman
- Bob Entringer
- Robert Fischer
- Kyle Forster
- Al Frank
- Carolyn Frank
- Lowell Fruhwirth
- Gilberto Gonzalez
- Mark Gonzalez
- Kent Hauge
- Rodney Hoff
- Kevin Holm
- Scott Hopfauf
- Bill Heuther
- Don Jensen
- George Keiser
- Fred Kraft
- Les Larson
- Paul Maddock
- Harvey Melstad
- Kelly Moldenhauer
- Ed Murphy
- Larry Nieters
- Scott Olson
- Chad Orn
- Jason Petryszyn
- Art Rhode
- Scott Rising
- Lon Romsaas
- Dennis Sailer
- June Skuza
- Donna Schauer
- Robert Schauer
- Steve Smokey
- Anita Thomas
- Kevin Thomas
- Scott Wegner
- John Westbee

Tyler Coulee Watershed Master Plan

Storm water master planning:

- Evaluates the impacts associated with runoff generated by existing and future development
- Determines facilities required to accommodate runoff to protect the watershed

The Tyler Coulee study focuses on the regional facilities

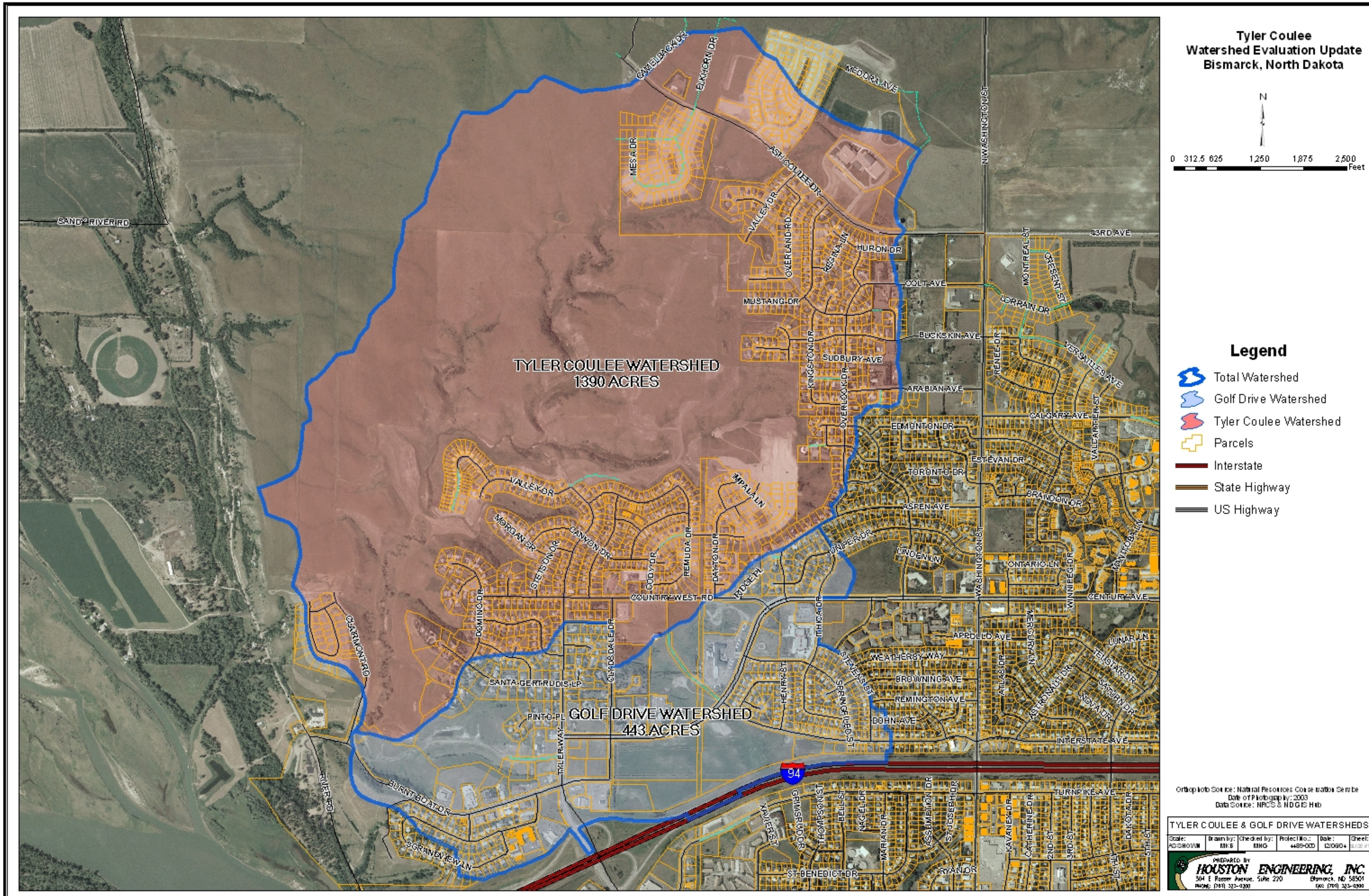
Future development

- Existing and future zoning – What does it look like?
- Planning horizon timelines
  - 2005 today
  - 2015 tomorrow
  - 2025 full development

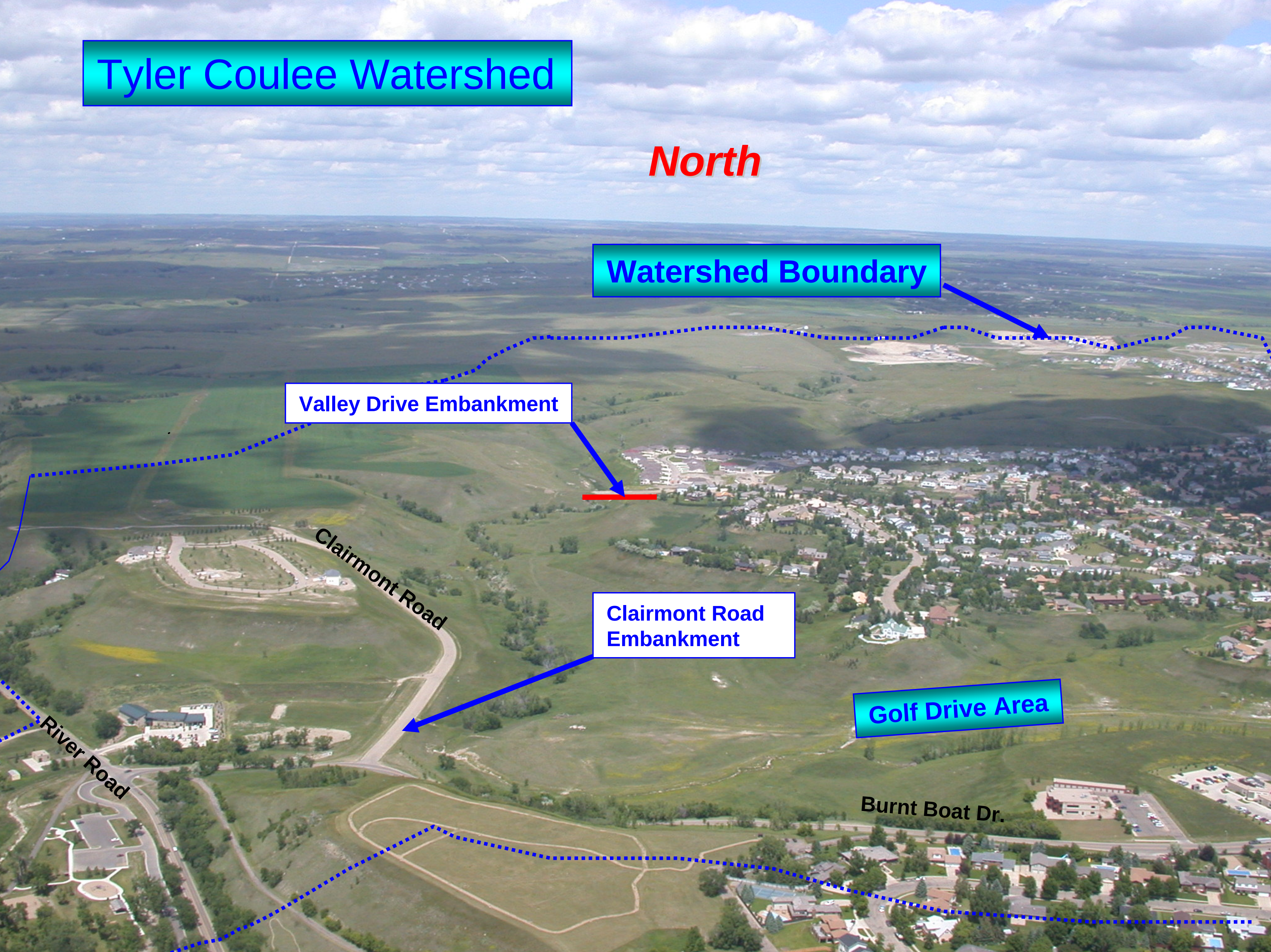
Tyler Coulee
Watershed Master Plan

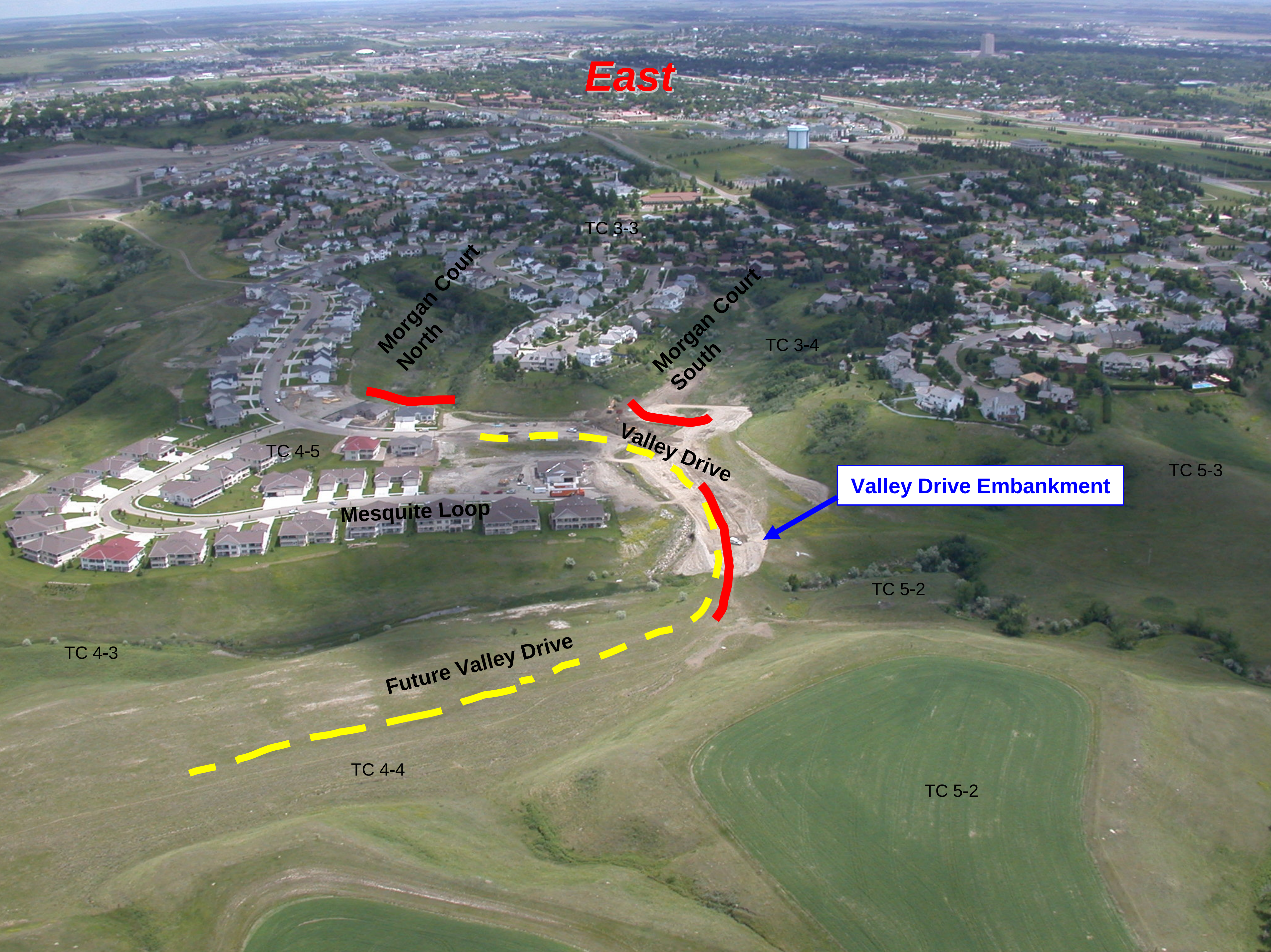
- **Regional Drainage Improvements** **(Tyler Coulee)**
  - Valley Drive Embankment
  - Tyler Parkway Embankment
  - Valley Drive East Embankment
  - Eagle Crest Embankment
  - Overland Road Embankment

- **Regional Drainage Improvements** **(Golf Drive)**
  - Golf Drive Storm Water Drainage Corridor

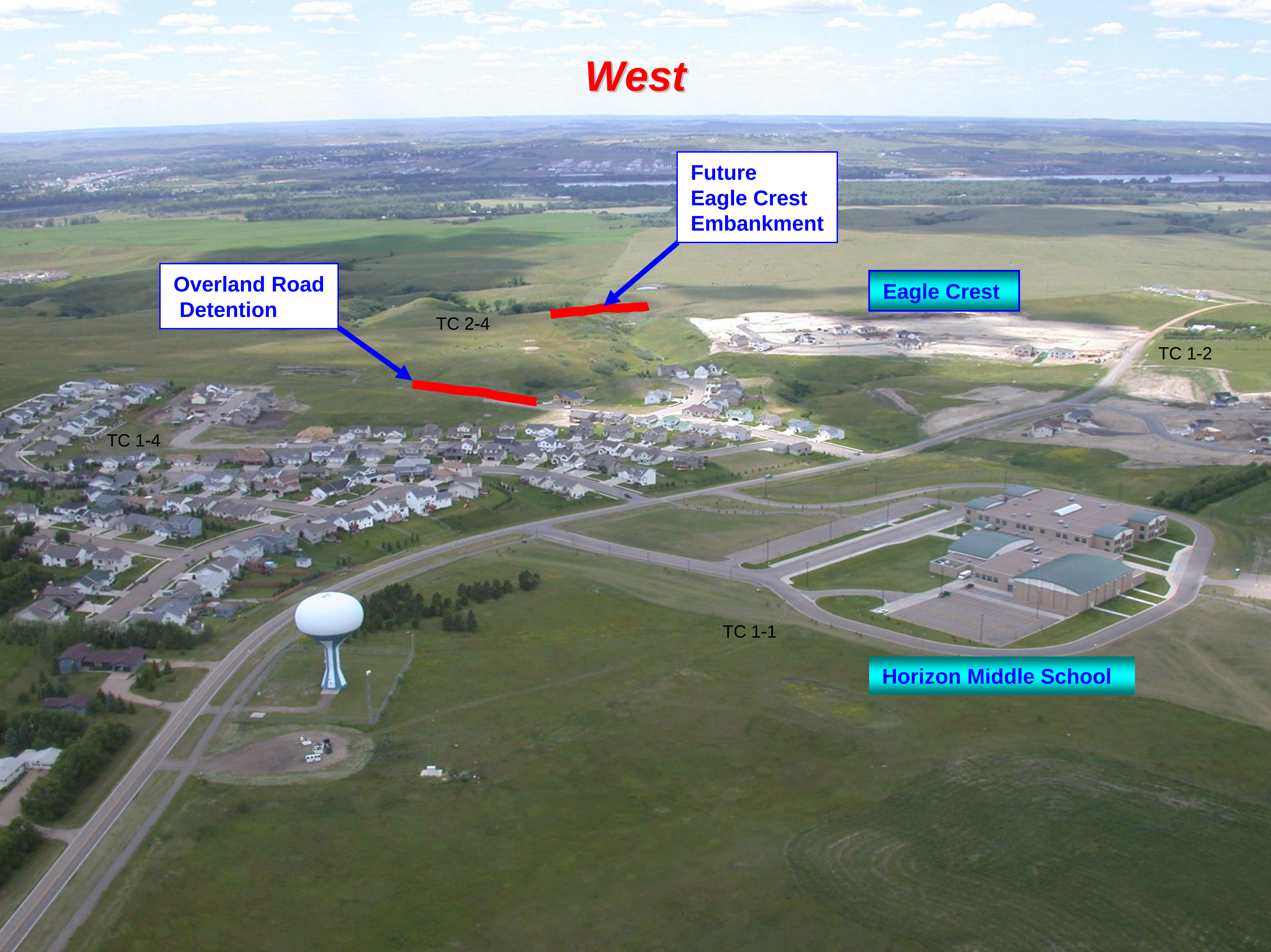


Tyler Coulee
Watershed Evaluation Update
Bismarck, North Dakota
N
0 312.5 625 1,250 1,875 2,500 Feet
Legend
Total Watershed
Golf Drive Watershed
Tyler Coulee Watershed
Parcels
Interstate
State Highway
US Highway
TYLER COULEE WATERSHED
1390 ACRES
GOLF DRIVE WATERSHED
443 ACRES
94
SANDY RIVER RD
CAMELBACK DR
ELKHORN DR
MEDORA AVE
MESA DR
ASH COULEE DR
N WASHINGTON ST
43RD AVE
VALLEY DR
OVERLAND RD
REGINA LN
HURON DR
COLT AVE
MUSTANG DR
BUCKSKIN AVE
KINGSTON DR
SUDBURY AVE
OVERLOOK DR
ARABIAN AVE
EDMONTON DR
CALGARY AVE
TORONTO DR
EST EVAN DR
BRANDON DR
ASPEN AVE
IMPALA LN
MORGAN DR
CANYON DR
STETSON DR
REMUDA DR
DAYTON DR
CODY DR
JUNIPER DR
LINDEN LN
ONTARIO LN
WINNIPEG DR
CENTURY AVE
COUNTRY WEST RD
RIDGE PL
DOMINO DR
CLAIRMONT RD
SANTA GERTRUDIS LP
CLYDESDALE DR
ITHICA DR
APPOLLO AVE
WEATHERBY WAY
BROWNING AVE
REMINGTON AVE
DOHN AVE
STEVENS ST
SPRINGFIELD ST
HENRY ST
PINTO PL
TYLER WAY
INTERSTATE AVE
BURNT BOAT DR
GRANDVIEW LN
RIVER RD
TURNPIKE AVE
ST BENEDICT DR
RYAN DR
LUNAR LN
TELSTAR DR
MERCURY LN
ATLAS DR
ASTRONAUT DR
MONTREAL ST
CRESCENT ST
LORRAIN DR
RENEE DR
VERSAILLES AVE
VALCARTIER ST
MANITOBA LN
Orthophoto Source: Natural Resources Conservation Service
Date of Photography: 2003
Data Source: NRCS & NDGIS Hub
TYLER COULEE & GOLF DRIVE WATERSHEDS
Drawn by: MKB
Checked by: MHG
Project No.: 4489-000
Date: 12/06/04
PREPARED BY
HOUSTON ENGINEERING, INC.
304 E Rosser Avenue, Suite 220
Bismarck, ND 58501


Tyler Coulee Watershed
North
Watershed Boundary
Valley Drive Embankment
Clairmont Road
Clairmont Road Embankment
Golf Drive Area
River Road
Burnt Boat Dr.


East
TC 3-3
Morgan Court North
Morgan Court South
TC 3-4
TC 4-5
Valley Drive
Valley Drive Embankment
TC 5-3
Mesquite Loop
TC 5-2
TC 4-3
Future Valley Drive
TC 4-4
TC 5-2


East
TC 2-6
Valley Drive East
Detention
TC 3-2
TC 2-7
Future Tyler Parkway
Future
Tyler Parkway
Embankment
TC 4-1
TC 4-3
TC 4-2
~ Development Control Line


West
Future
Eagle Crest
Embankment
Overland Road
Detention
TC 2-4
Eagle Crest
TC 1-2
TC 1-4
TC 1-1
Horizon Middle School

Tyler Coulee Watershed Master Plan

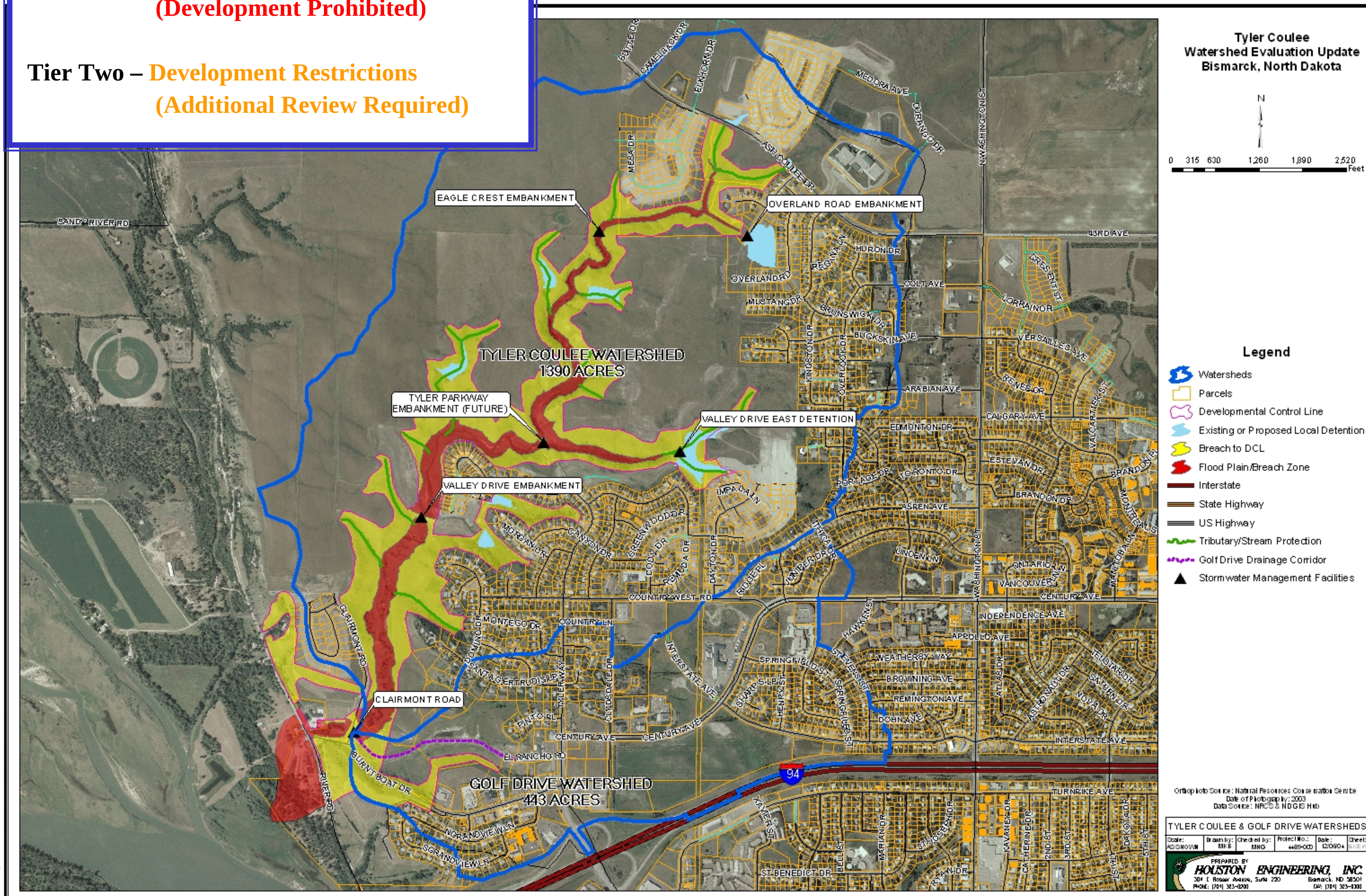
Regional Project Features	Opinion of Cost
Tyler Coulee Watershed	
Valley Drive Embankment	$ 1,245,000
Tyler Parkway Embankment	$ 1,028,000
Valley Drive East Embankment	$ 101,000
Eagle Crest Embankment	$ 500,000
Overland Road Embankment	$ 381,000
Subtotal	$ 3,255,000
Golf Drive Corridor	$ 800,000
Total Project Cost	**$ 4,055,000**

Note: Project costs include design, construction, engineering, administration, bonding, etc…

Development Control Line (DCL)

Tier One – Floodplain/Breach Zone
(Development Prohibited)

Tier Two – Development Restrictions
(Additional Review Required)



Tyler Coulee Watershed Master Plan

Special Assessment Equalization

- Current Special Assessment Process
  - Properties are given credit for previous storm water special assessments to equally spread the costs of storm water improvements that are constructed in phases


Regional Storm
Water Detention

Tyler Coulee
Watershed Master Plan

- **Local Drainage Improvement**
  - Convey runoff generated by properties directly draining into the storm water system
  - Typically serve one or more developed or undeveloped areas
  - Connect to the regional storm water systems

Tyler Coulee Watershed Master Plan

- **Regional Drainage Improvement**
  - Convey runoff generated by properties directly or indirectly draining into the storm water system
  - Typically collect storm water from local improvements
  - All properties within a watershed contribute/benefit from regional improvements
  - Benefits include storm water conveyance, flood damage reduction, reduced downstream infrastructure costs, environmental protection, water quality improvements, and green space

Tyler Coulee Watershed Master Plan

Regional Drainage Improvements

- **Funding Alternatives**
  - Revise special assessments to include properties outside city limits
  - Require developers to pay an upfront fee
  - Increase monthly storm water utility charge city-wide to pay for all storm water improvements
  - Burleigh County Water Resource District
  - Utilize sales tax for improvements
  - Grants

Tyler Coulee Watershed Master Plan

Regional Drainage Improvements

- **Funding Recommendation**
  - Revised special assessment process
    - Include property outside city limits
    - Establish revolving storm water fund with $1 fee
      - Use fund to hold costs of improvements for property outside city limits until annexed

Tyler Coulee Regional Improvements Cost Distribution		Projected Assessable Acreage		Not Assessable
Tyler Coulee Watershed	**Opinion of Probable Cost**	**City Limits Platted Area (acres)**	**Undeveloped Property (acres)**	**DCL Area (acres)**
Valley Drive Embankment	$1,245,000			
Tyler Parkway Embankment	$1,028,000			
Valley Drive East Embankment	$101,000			
Eagle Creek Embankment	$500,000			
Overland Road Embankment	$381,000			
Subtotal	$3,255,000	429	390	298
Golf Drive Watershed	$800,000	287	31	19
		716	421	318

Assessment District Cost Distribution		Projected Cost (sq. ft.)	Old Method Cost (sq.ft.)
Tyler Coulee	$1,705,062	$0.0912	$0.174
Golf Drive	$722,622	$0.058	$0.064
Subtotal	$2,427,685		
City of Bismarck Cost Abeyance	$1,627,315		
Total Regional Project Cost	$4,055,000		

Tyler Coulee
Watershed Master Plan

Local Drainage Improvements

- **Funding Alternatives**
  - Revise special assessment process
    - Include properties outside of city limits
  - Require developers to pay an upfront fee
  - Require developers to design and construct all storm water improvements within the local drainage areas

Tyler Coulee
Watershed Master Plan

Local Drainage Improvements

- **Funding Recommendations**
  - Revised special assessment process
    - Include properties outside city limits
- **Typical Costs**
  - Local storm water improvements typically range from $.04 to $.14 per square foot

Tyler Coulee Watershed Master Plan

Next Steps

- Presentation of work group recommendations to the Bismarck City Commission – December 14
- Completion of storm water master plan by Houston Engineering, Inc.
- Update of city policies and ordinances to implement recommended changes

Tyler Coulee
Watershed Master Plan

Please thank your neighbors who served on one or both work groups

THANK YOU!

Tyler Coulee Watershed Master Plan

The suggestions and concerns you voice tonight will be taken to the December 14 commission meeting.

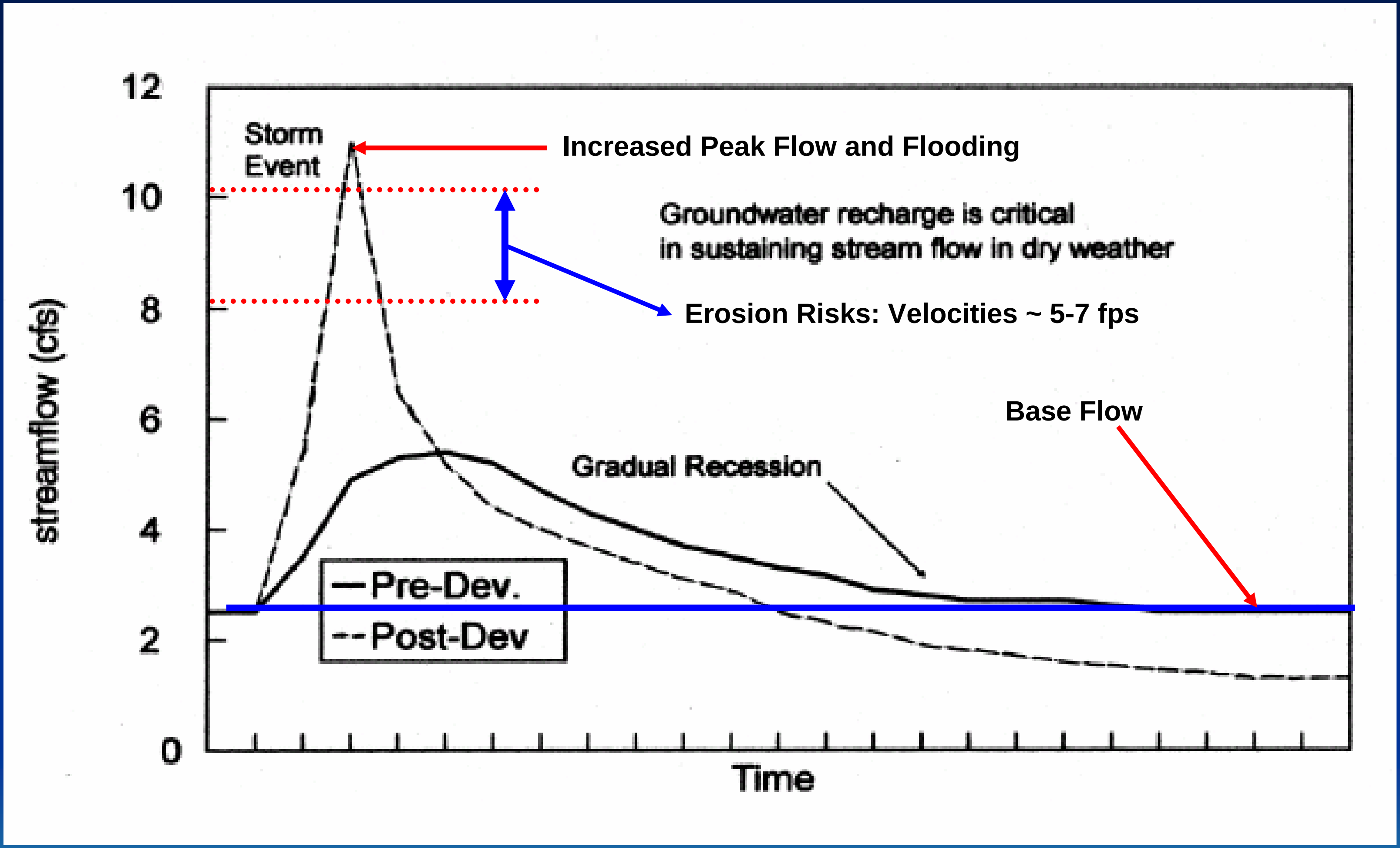
Questions?

Storm Water Master Planning Process

- Watershed Evaluation
  - Document Existing Conditions
    - Storm Water Management & Conveyance Facilities
    - Problem Areas (erosion, flooding, water quality)
  - Project Future Development
    - Projected Land Use and Variations (zoning)
    - Potential Impact Areas (flooding, erosion, etc…)
    - Available Alternatives (structural and non-structural)
    - Best Management Practices (BMP's)

Where is the study today and why are we here?

Development's Effect on Runoff



Our activities affect peak flows, runoff volume and flow duration.

Hydrologic Analysis

Existing Conditions - Hydrologic Modeling

- 2001 Storm Water Management Model (SWMM)
  - EPA Water Quality Modeling (Section 319 funding)
  - Peak Flows, Runoff Volumes & Flow Durations
  - Existing Detention Storage
  - Potential Future Detention Storage

- Existing Facilities Modeled
  - Existing and Approved Subdivisions
  - Clairmont Road
  - Valley Drive
  - Valley Drive East
  - Overland Road

Alternative Analysis

- Approved Developments (under construction)
  - Hydrologic Modeling Completed
    - Horizon Heights
    - Eagle Crest
    - K&L Additions
    - Country West XXVII
      - Mesquite Loop (Morgan Court Detention)
    - Other Subdivisions – Beyond the Baseline

Alternatives

Where do we go from here?

- **Projecting Future Development**
  - **Hydrologic Modeling**
    - **Modifications to Existing Facilities**
    - **Alternatives for New Facilities**
      - **Purpose for this work group – What should these alternatives look like?**
  - **Design Objectives, Values and Aesthetics**
    - **Storm Water Management Design Criteria**
    - **Green Space (grass, trees, native areas….)**
    - **Development Control Lines (DCL)**
    - **Parks and Recreation**
    - **Environmental Enhancements**

Feedback Opportunities

Minimum Criteria for an Alternative

- Stream channel “protection”
- Safety (floodplain & dam breech)
- Property damage prevention
- Slope protection – erosion
- Water quality (minimize sediment)

“Baseline” (Traditional) Alternatives

- Master planned system
- Reduce regional detention
- Replace/Move regional detention
- Add local detention facilities
    - Smaller & greater in #
- Combinations of above

“Enhanced” Alternatives

- Low impact development
- Reduced density
- Enhanced “Baseline”

Additions to the Minimum Criteria

- Greenspace / Parks / Trails
- Protect ecological uniqueness (trees, native plants, slopes)
- Aesthetics
- Development restrictions

Alternative Evaluations

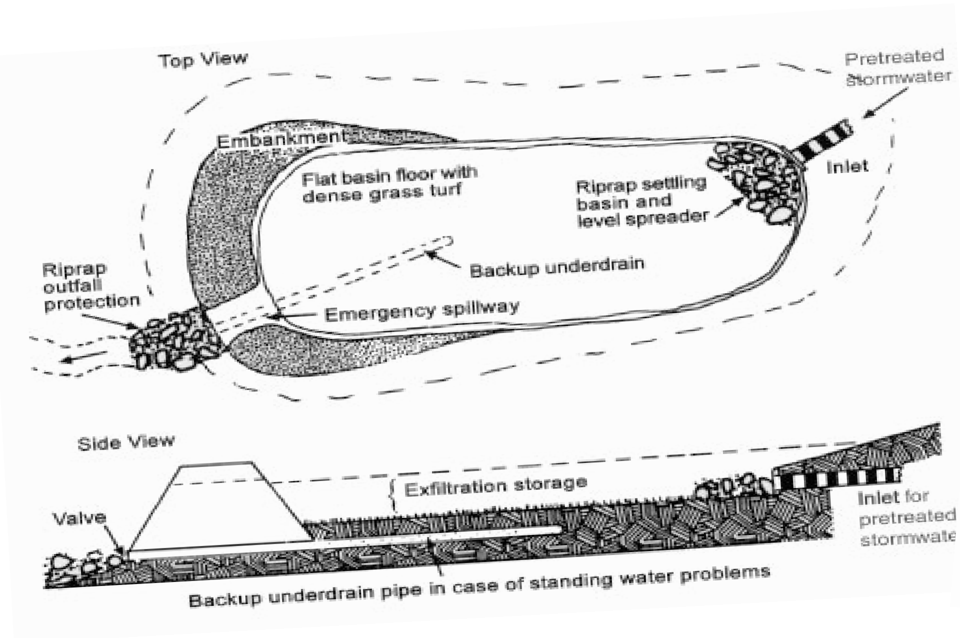
- Existing Conditions – Baseline
- Projected Future Conditions
  - Development Types
    - Typical Urban Development (4 lots/acre)
    - Low Density Development (2 lots/acre)
    - Cluster Development
  - Conveyance Features
    - Street and Storm Sewer
    - Channel Control
    - Local Detention
    - Regional Detention
    - Environmental Features
  - Phased Development is Anticipated

Alternative Facilities

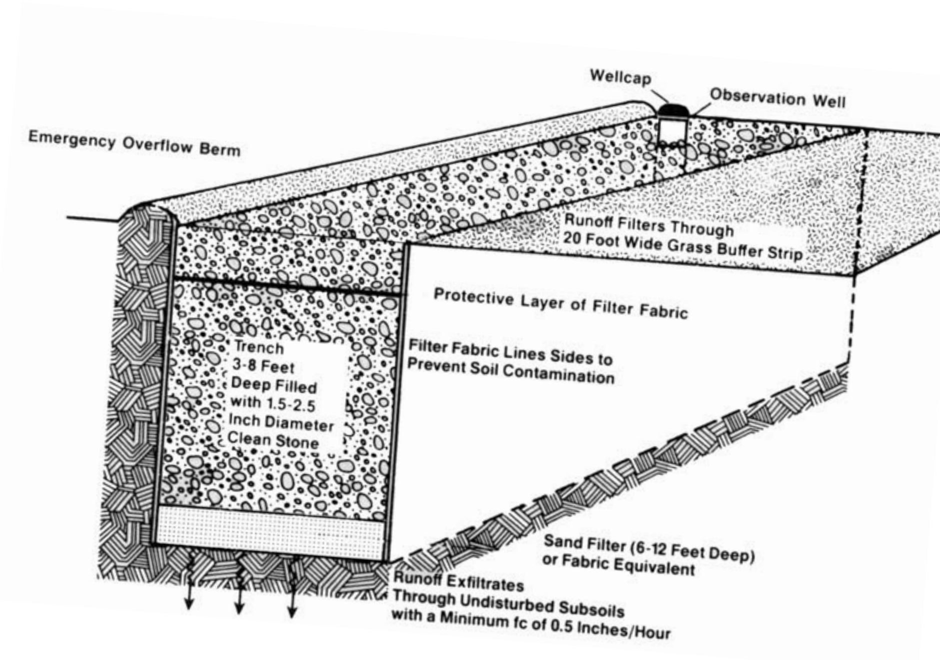
- **Streets and Storm Sewers (< 20 acres)**
- **Detention/Retention**
  - Regional (services the larger watershed)
  - Local (services individual development watershed)
- **Channel Stability**
  - Natural Conditions (3-7 feet/sec)
  - Regraded – Grass (2-3 fps)
  - Temporary Turf Reinforcement (2-5 fps)
  - Permanent Reinforcement (3-12 fps)
  - Trickle Flow Channel (riprap – concrete)
  - Low Flow Storm Sewer (base flows)
  - Check Structures (small dams – velocity control)
- **Others????**

Questions and Issues

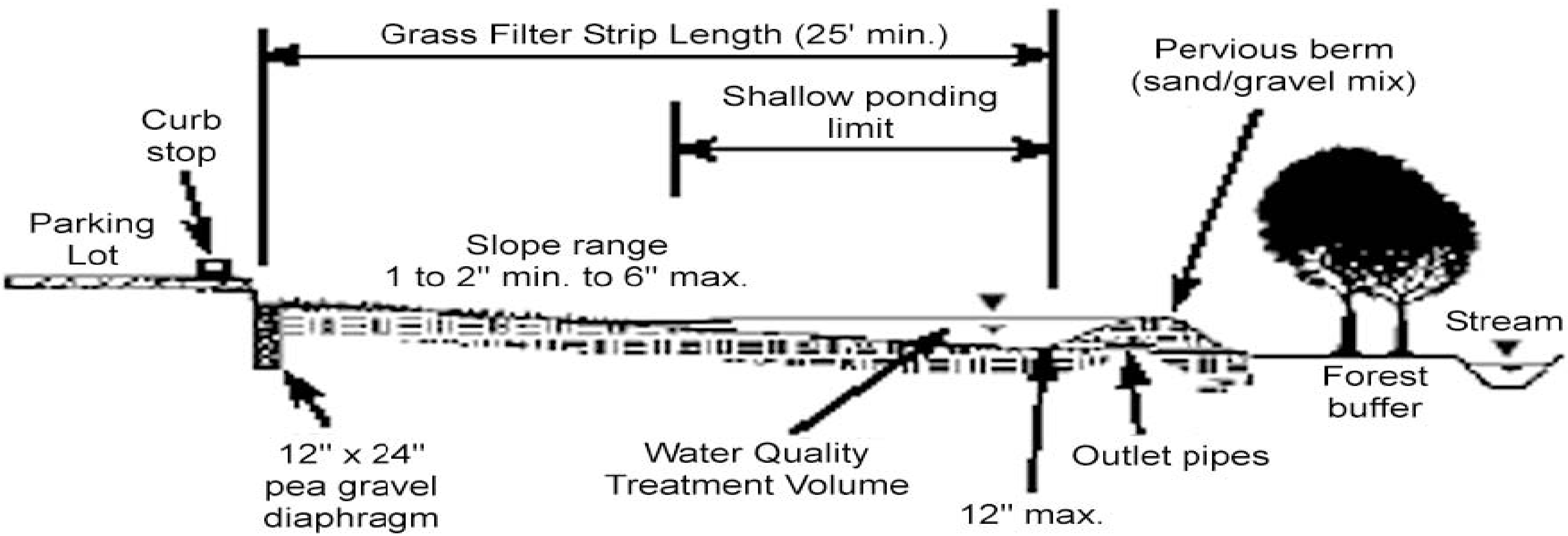
- What does the committee feel is a reasonable alternative approach?
- What is your opinion on establishing a Development Control Line (DCL) and where should it be located?
- What types of facilities are preferable, regional, local, natural, etc….
- What should the alternatives focus on?
- What are the critical issues to address when developing alternatives?



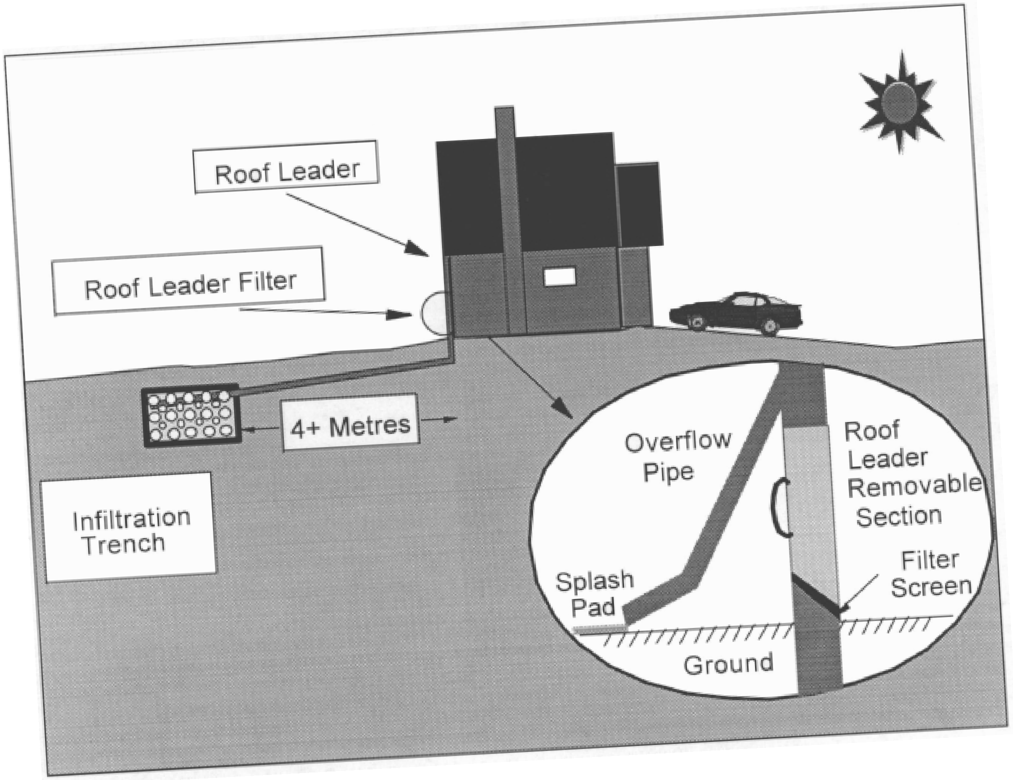
Typical Infiltration Basin Design



Typical Infiltration Trench Design



**Source: Metropolitan Council –
Environmental Services**



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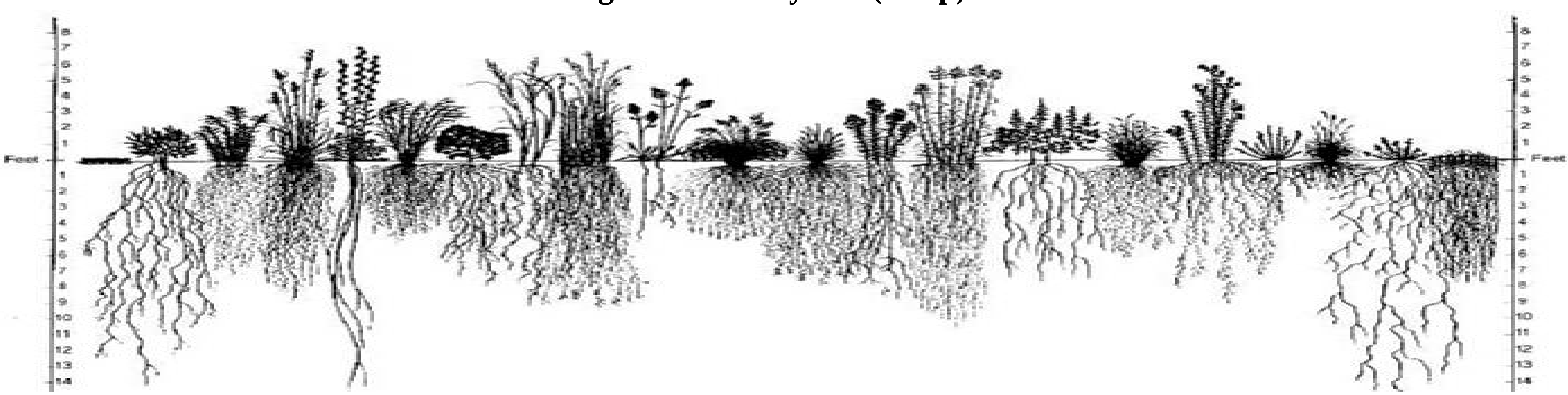
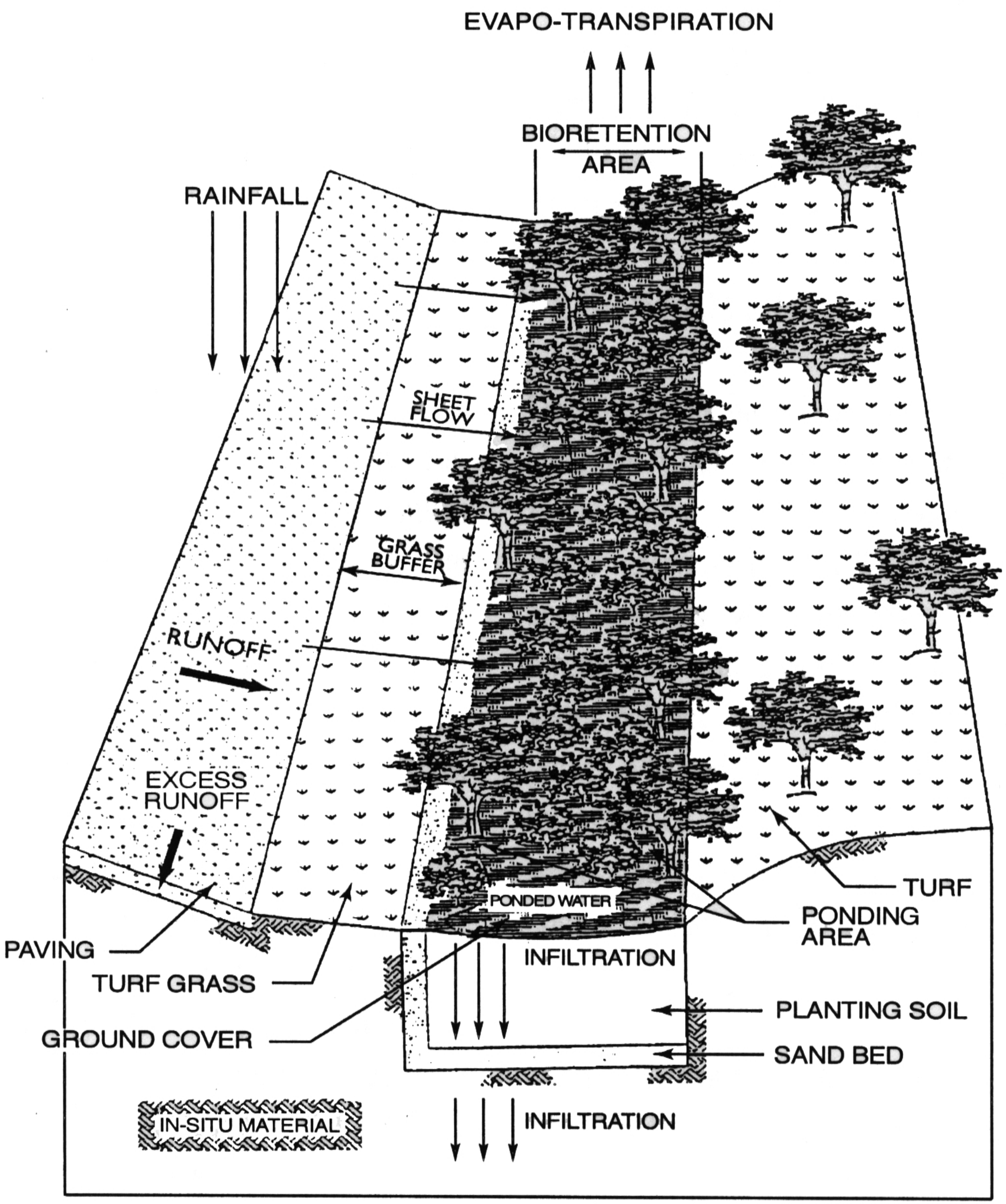
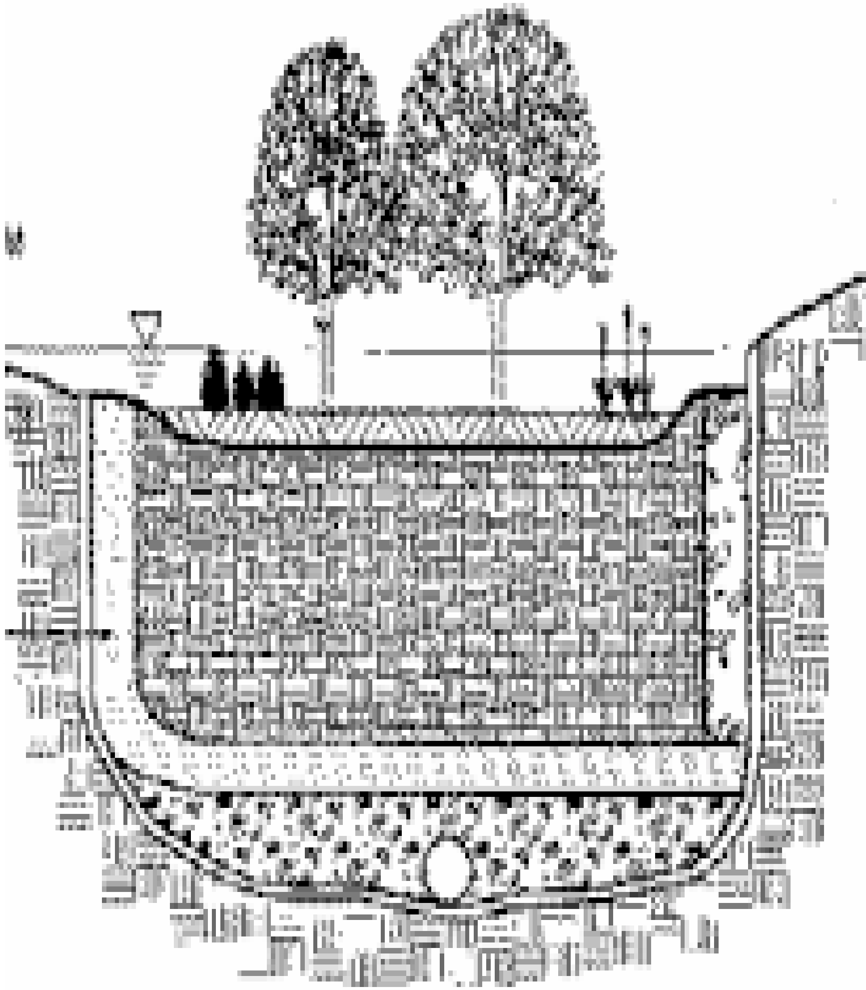


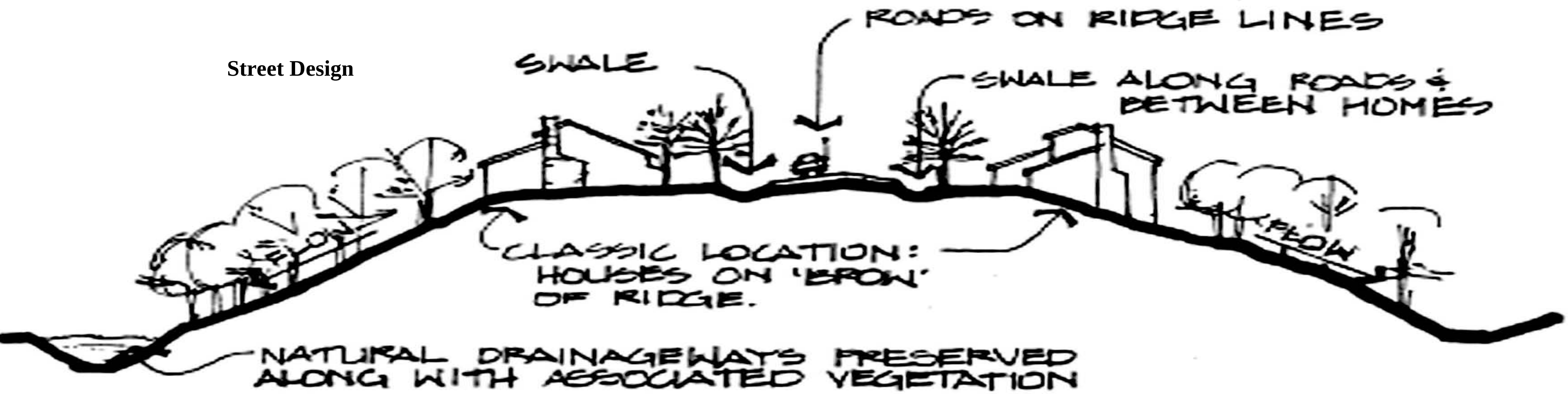
Bioretention Area Conceptual Layout (functioning like an Infiltration Basin)

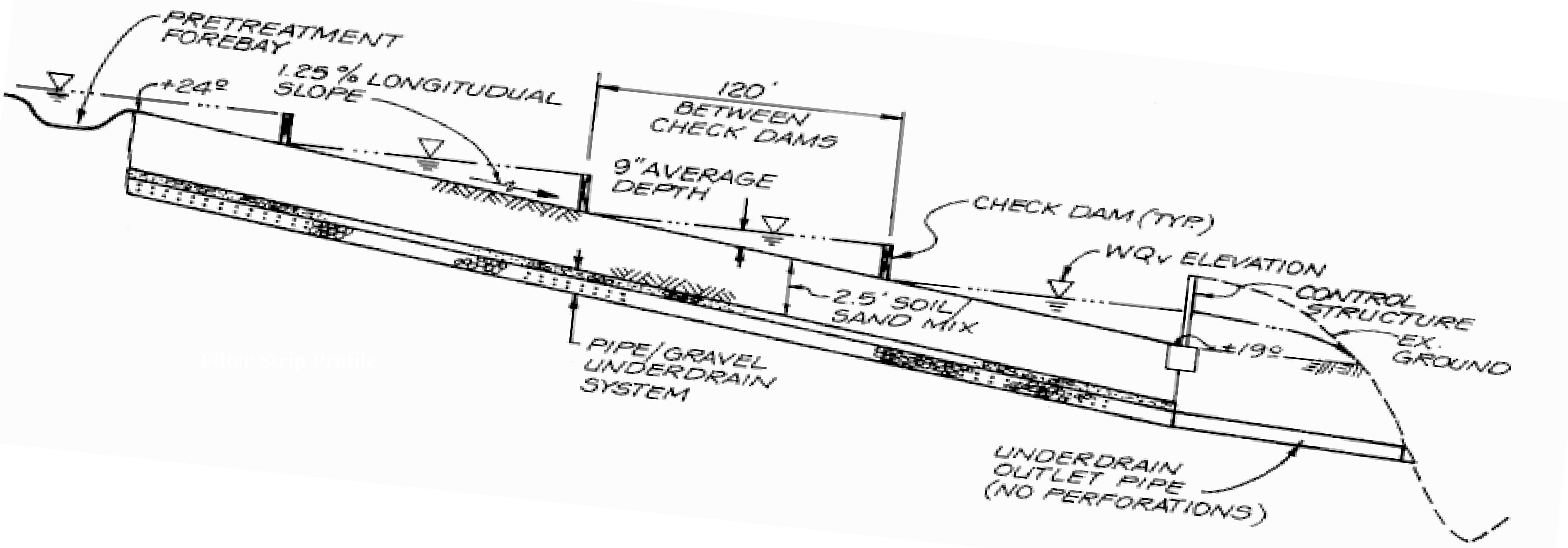




The Bioretention Concept

Street Design





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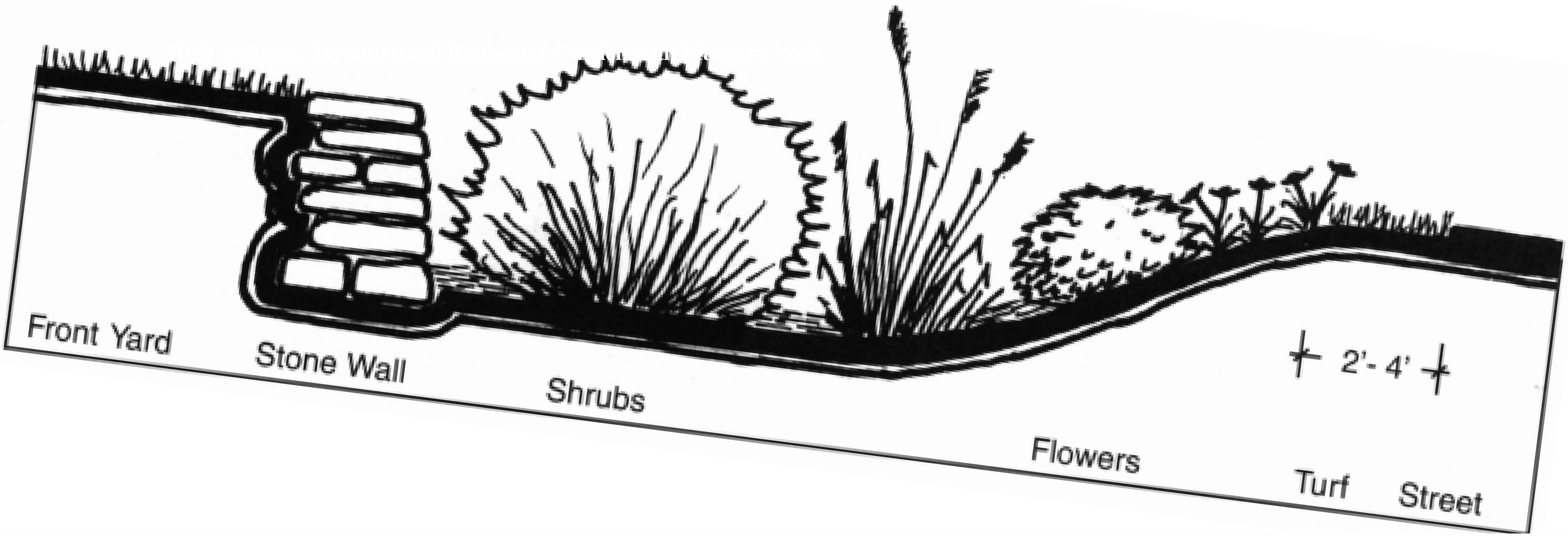
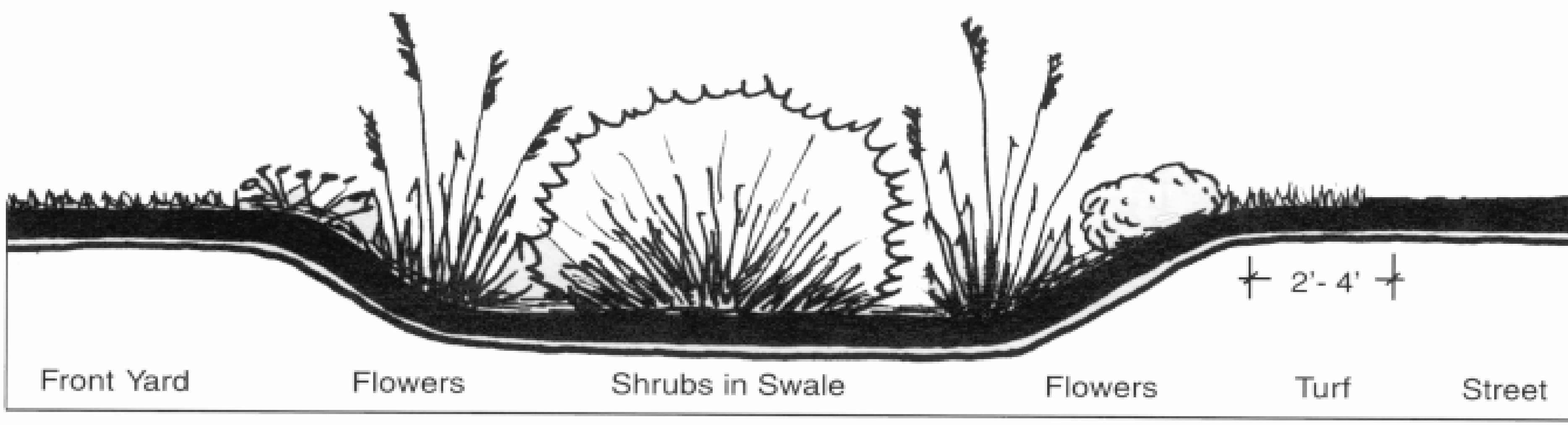
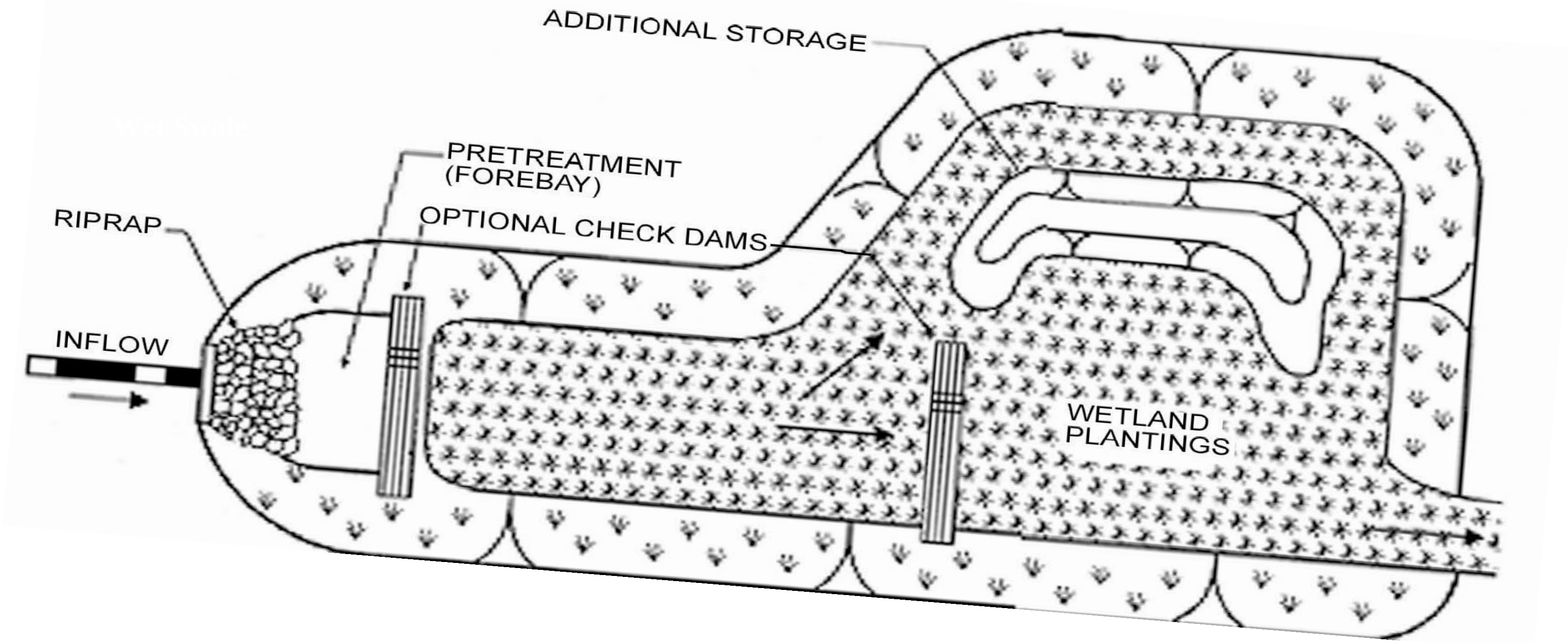
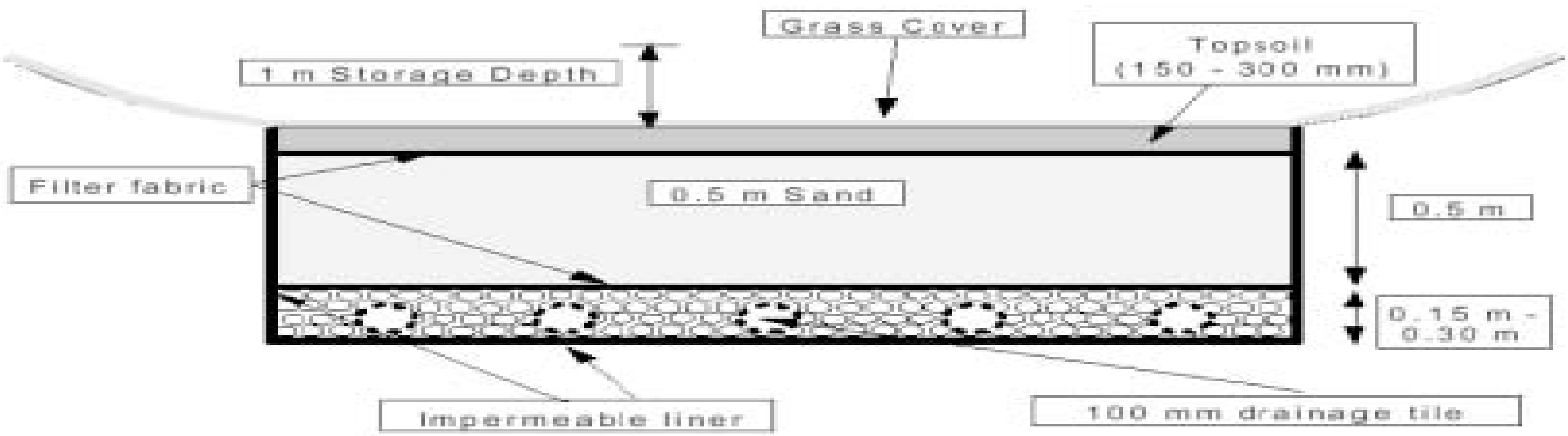


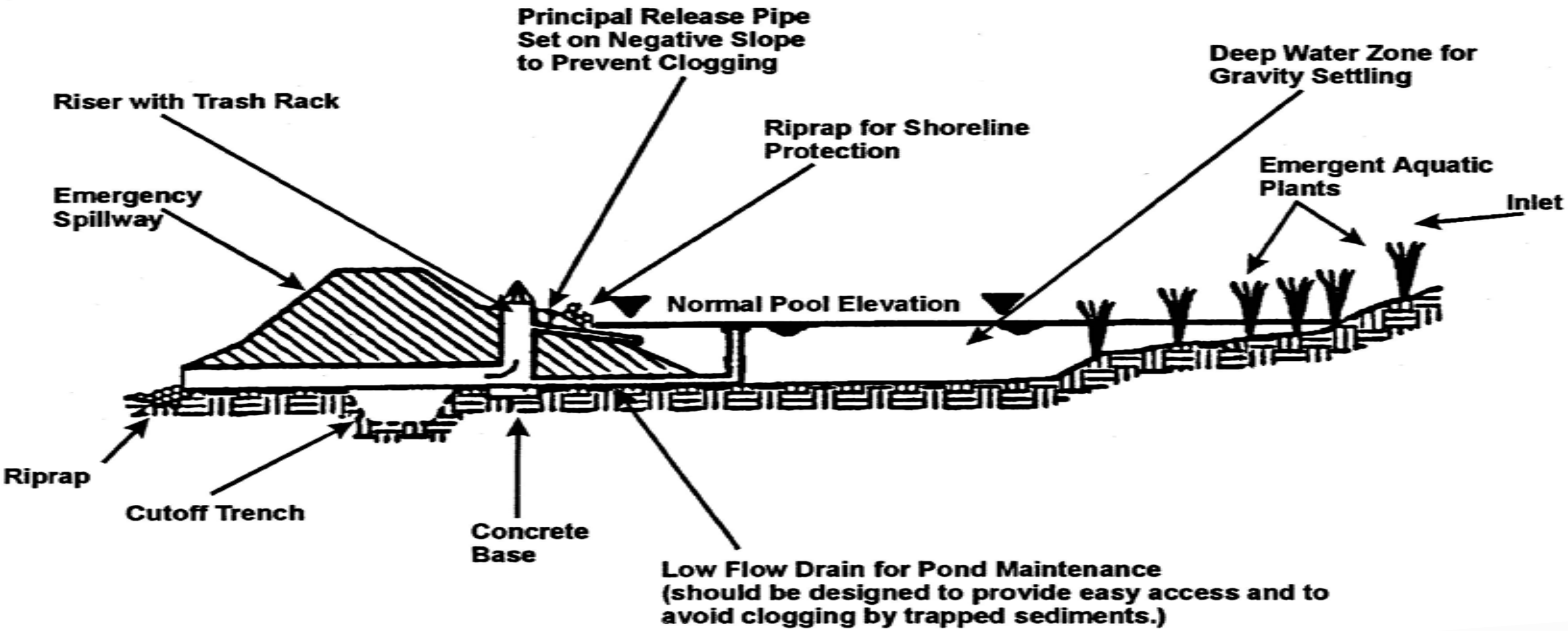


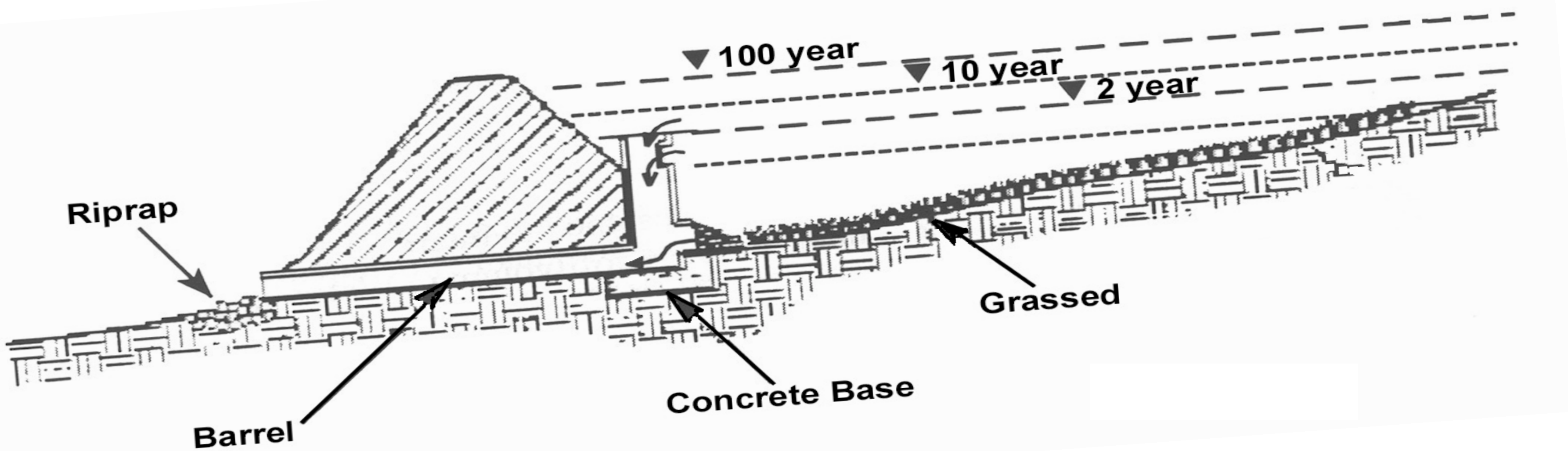
High Volume Symmetrical Rainwater Garden

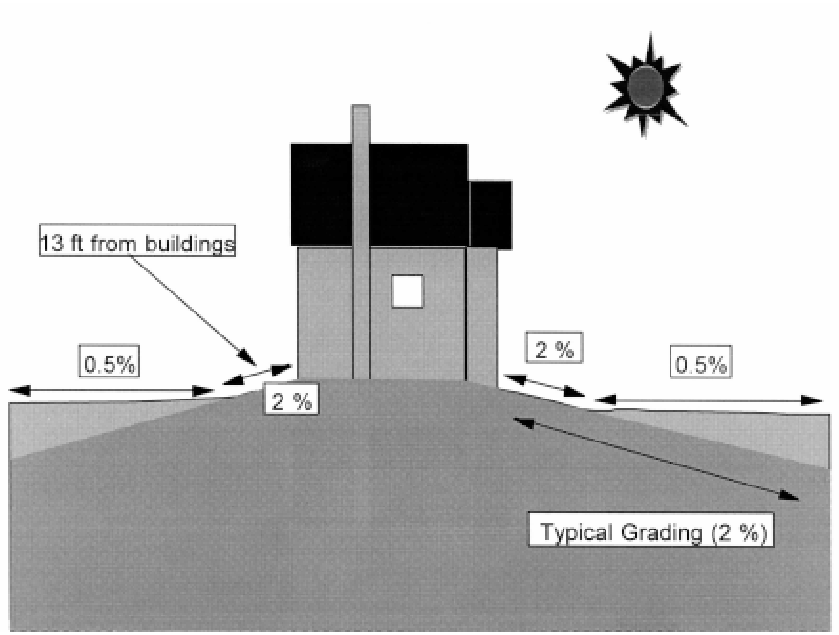


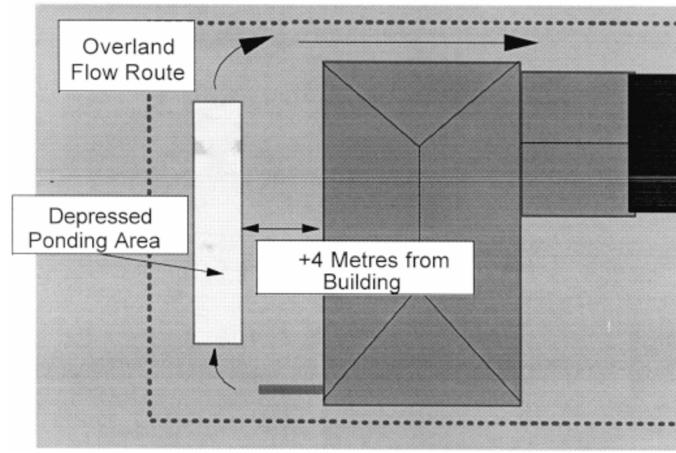


Sand Filter Cross Section


Principal Release Pipe
Set on Negative Slope
to Prevent Clogging
Deep Water Zone for
Gravity Settling
Riser with Trash Rack
Riprap for Shoreline
Protection
Emergent Aquatic
Plants
Emergency
Spillway
Inlet
Normal Pool Elevation
Riprap
Cutoff Trench
Concrete
Base
Low Flow Drain for Pond Maintenance
(should be designed to provide easy access and to
avoid clogging by trapped sediments.)


100 year
10 year
2 year
Riprap
Grassed
Concrete Base
Barrel





Example of Lot Grading changes

Project Contacts

Mr. Michael Gunsch
Project Manager
Houston Engineering, Inc.
304 East Rosser Avenue, Suite 220
Bismarck, North Dakota 58501-4012
(701) 323-0200
mgunsch@houstonengineeringinc.com

City Contact
Ms. Lisa Ansley
Engineering Department
221 N. Fifth Street, Box 5503
Bismarck, North Dakota 58506-5503
lansley@state.nd.us

Tyler Coulee Watershed Study

Public Informational Meeting
February 5, 2005

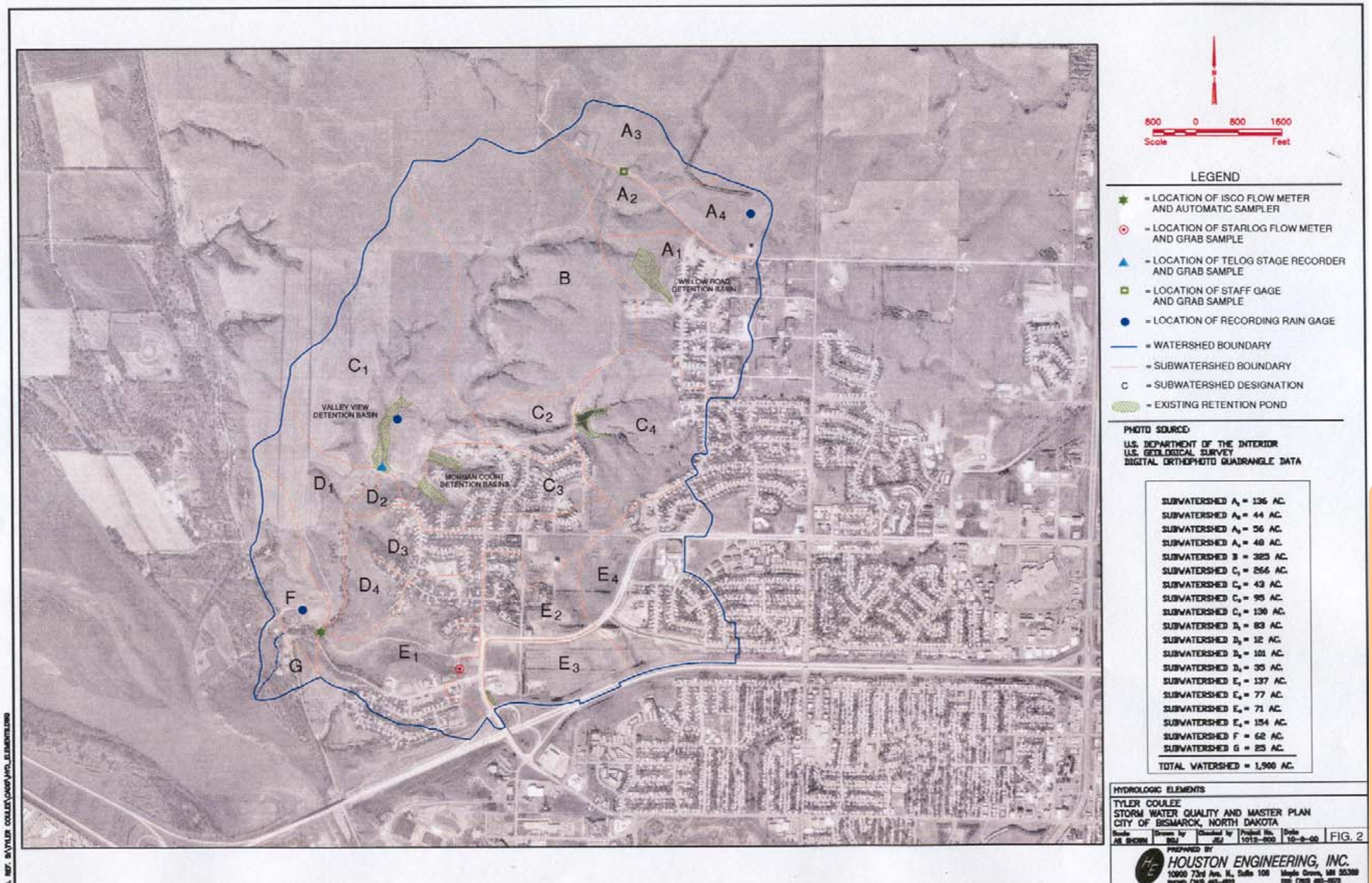
Houston Engineering, Inc.

Informational Meeting Format

- Convene meeting
- Opening remarks and introduction
- Presentation
- Workshop (Open house)
- Provide feedback

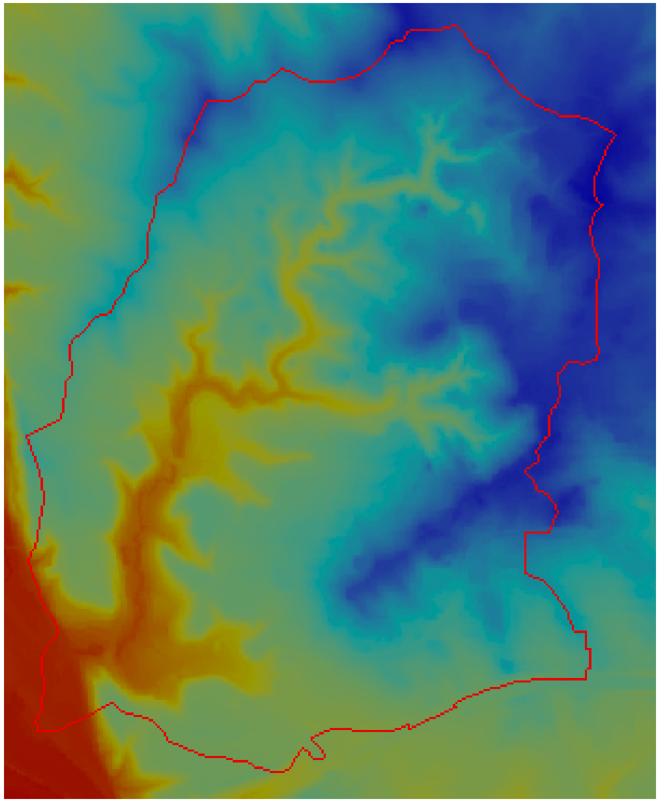
Meeting purpose is to provide information about the issues, study process and obtain public input.

Tyler Coulee



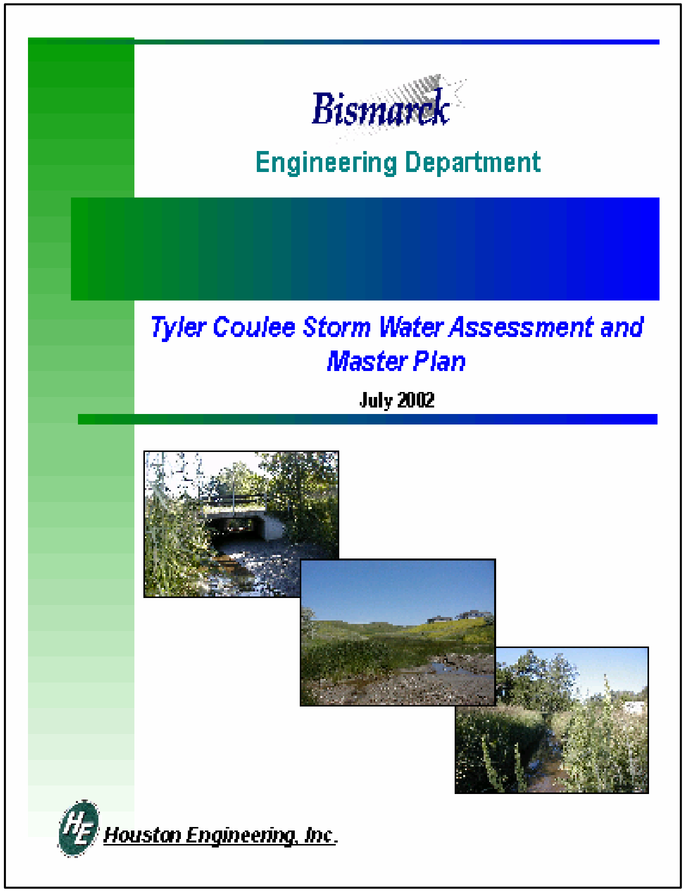
Tyler Coulee Storm Water Management Challenges

- Continued urbanization generates more runoff
- Stream channels can erode from excess runoff
- Reasonable use of Pioneer Park
- Uniqueness of the area (aesthetics, slopes, stream corridor)
- Public safety
- New rules



The Tyler Coulee Watershed presents unique challenges and opportunities for managing storm water runoff.

What has already been done to address these Challenges?



Updating the previous Master Plan is necessary as more refined development proposals are presented to the City.

Feedback Opportunities

Minimum Criteria for an Alternative

- Stream channel “protection”
- Conveyance through Pioneer Park
- Safety (floodplain & dam breech)
- Property damage prevention
- Slope protection – erosion
- Water quality (minimize sediment)

“Baseline” (Traditional) Alternatives

- Master planned system
- Reduce regional detention
- Replace / move regional detention
- Add local detention facilities
    - Smaller & greater in #
- Combinations of above

Additions to the Minimum Criteria

- Greenspace / Parks / trails
- Protect ecological uniqueness (trees, native plants, slopes)
- Aesthetics
- Development restrictions

“Enhanced” Alternatives

- Low impact development)
- Reduced density
- Enhanced “Baseline”

What should I expect before the next meeting?

- Technical stuff
  - Evaluating runoff (modeling)
  - Addressing safety issue
  - Identify strategies to address runoff (i.e., Alternatives)

- Stuff for the next public meeting
  - Alternatives being considered
  - Early results

Study completion is slated for early summer (~June) of 2004.

Providing Input

- Visit the tables
  - Table 1. Issue identification
  - Table 2. Options for Managing Storm Water
  - Table 3. Tour the Watershed
- Talk with a City representative
- Complete a questionnaire

Visit the tables and use the information to help formulate questions and provide feedback.

Thanks for Participating!

Project Point of Contact

Mr. Michael Gunsch
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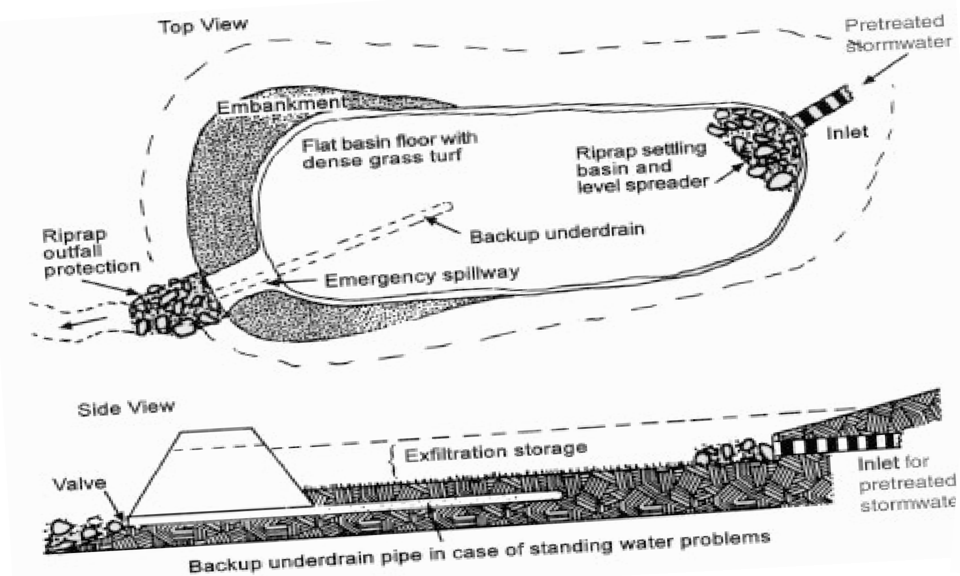
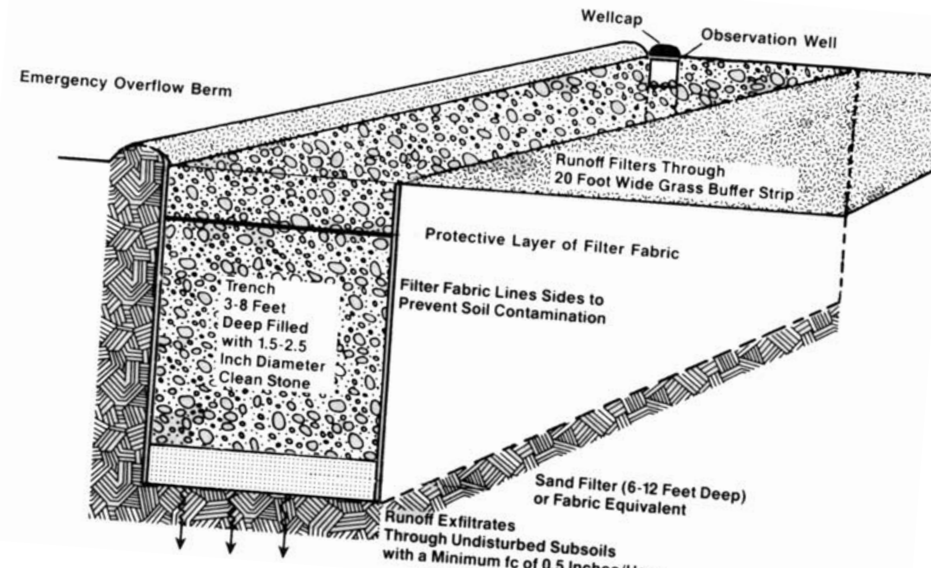
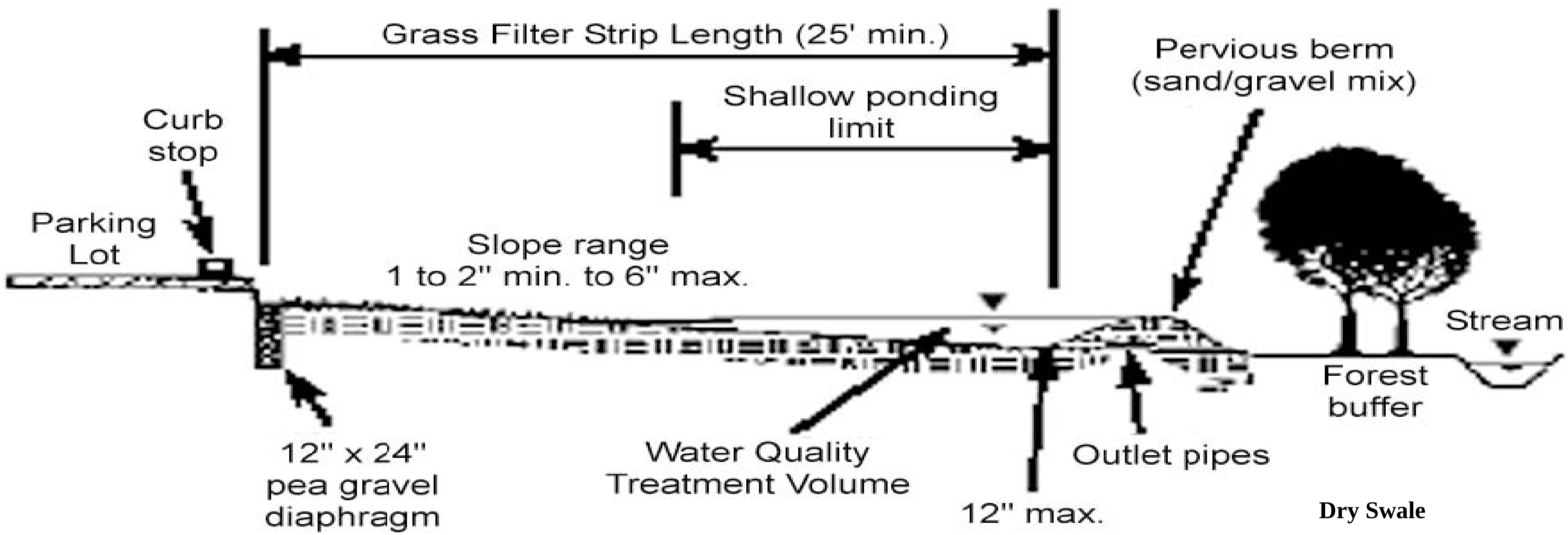


Typical Infiltration Basin Design

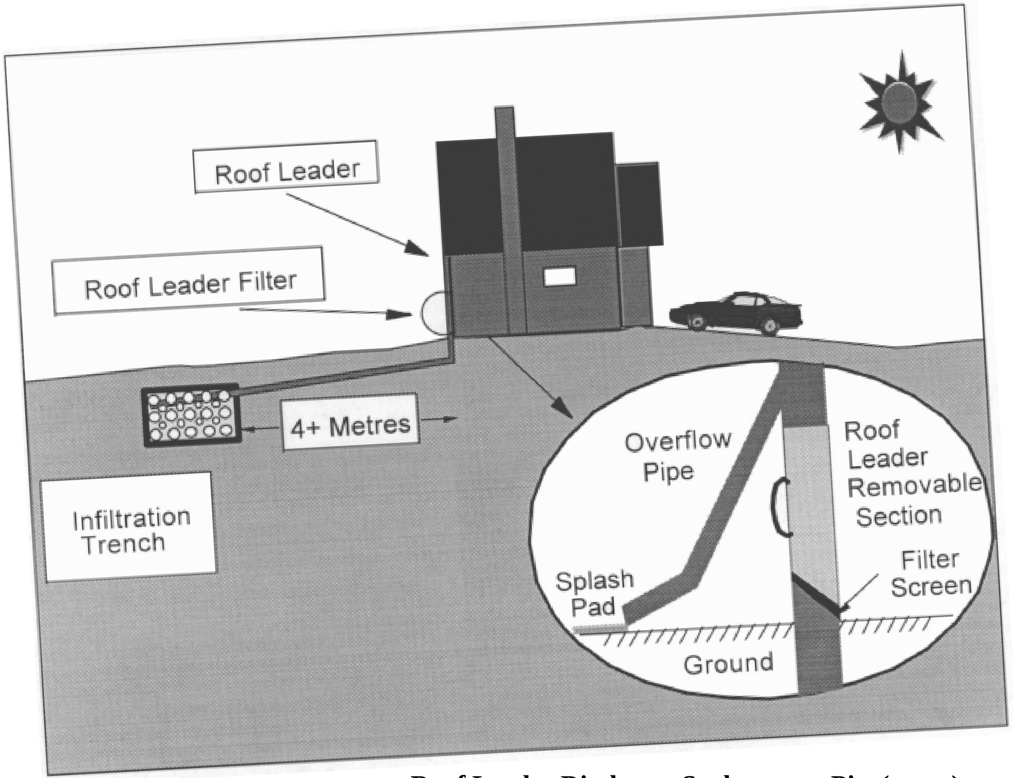


Typical Infiltration Trench Design



Dry Swale

Source: Metropolitan Council – Environmental Services



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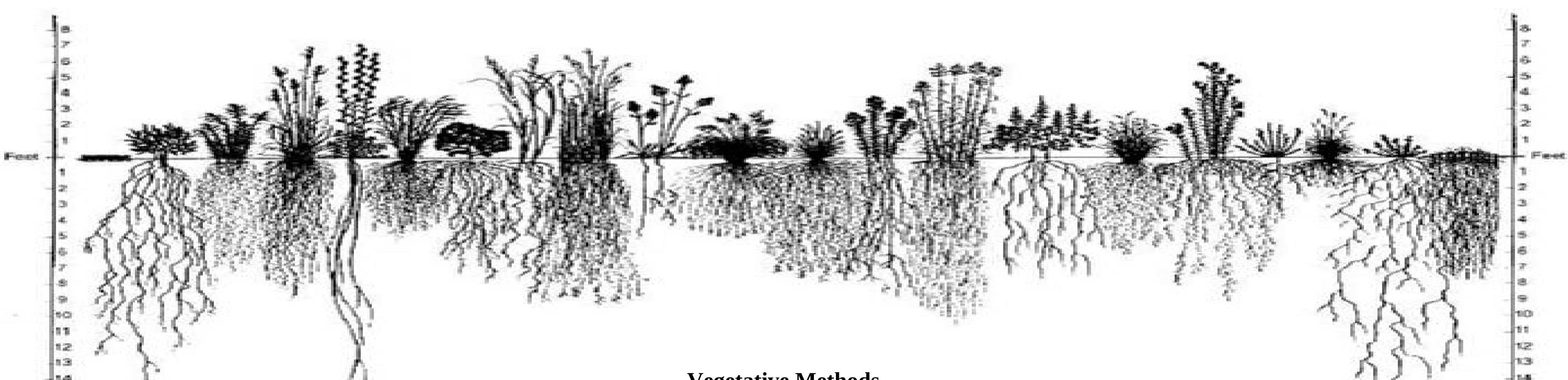
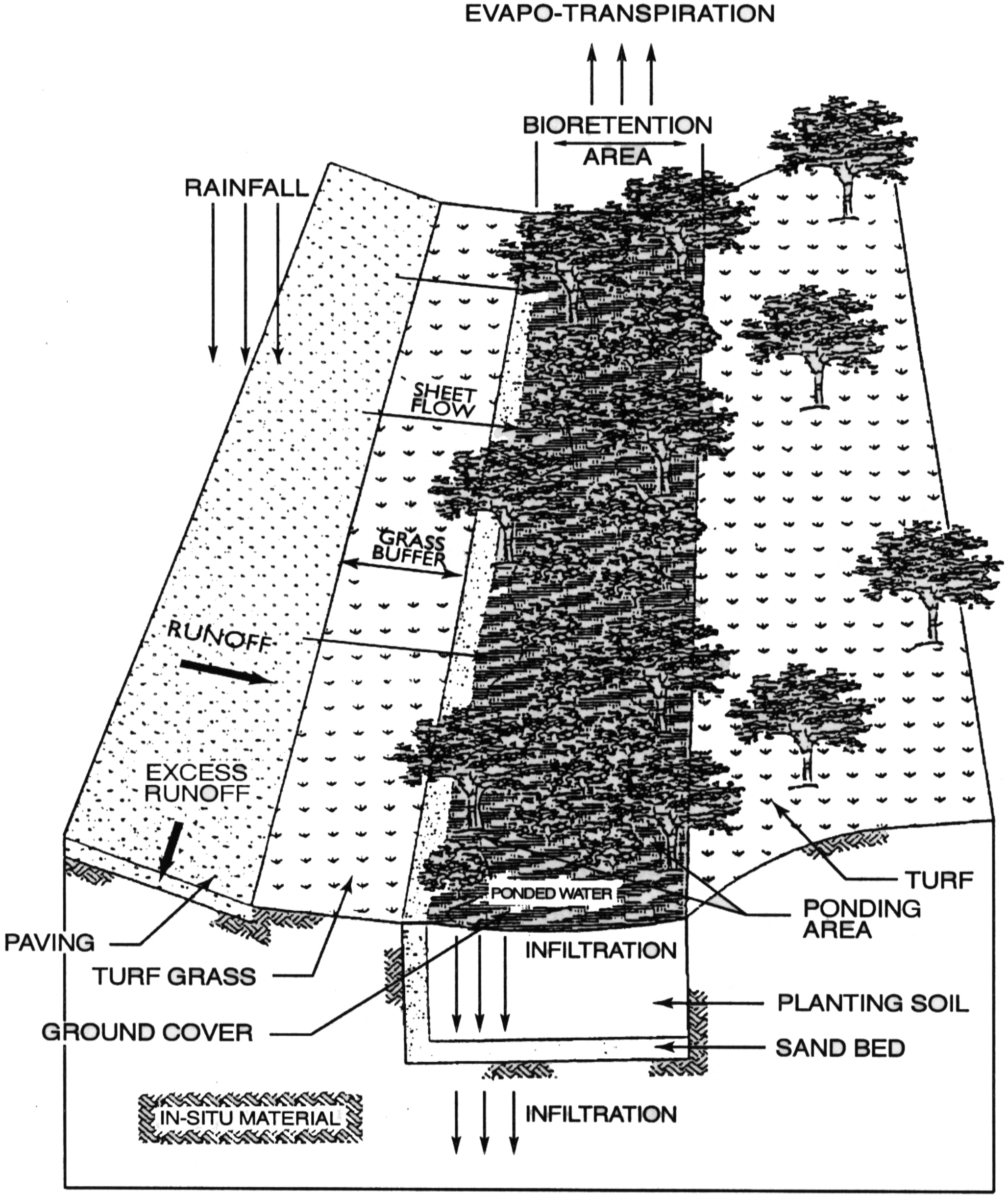
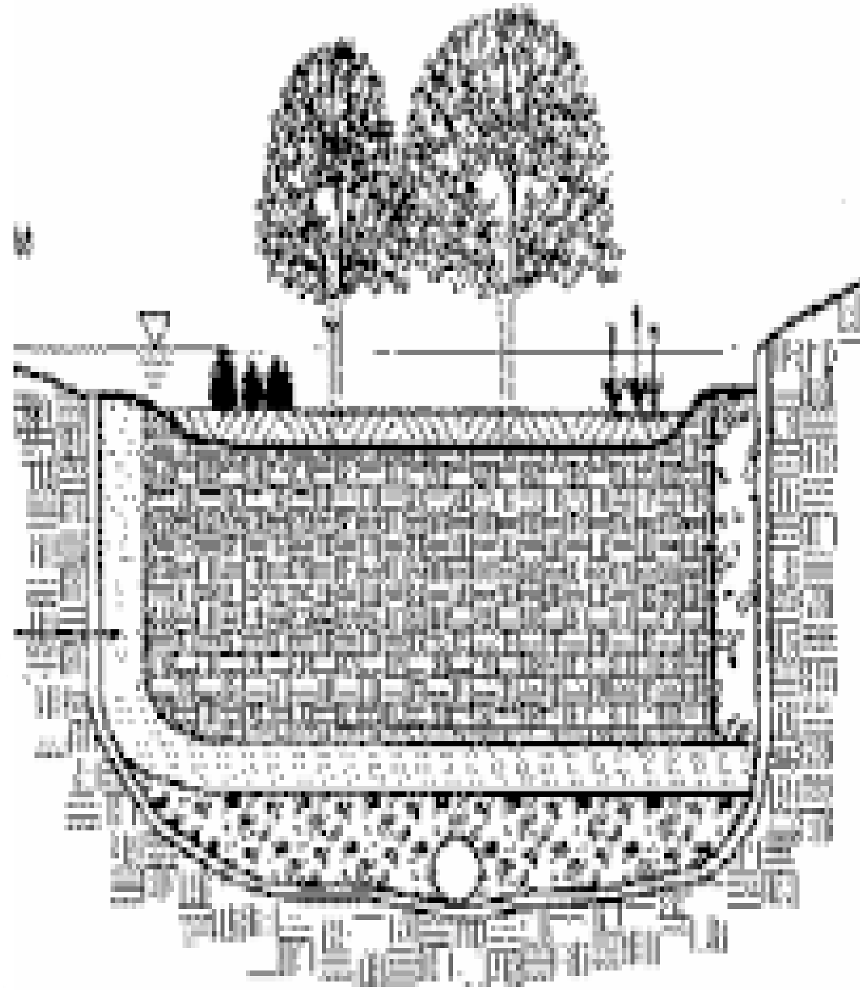


Vegetative Methods

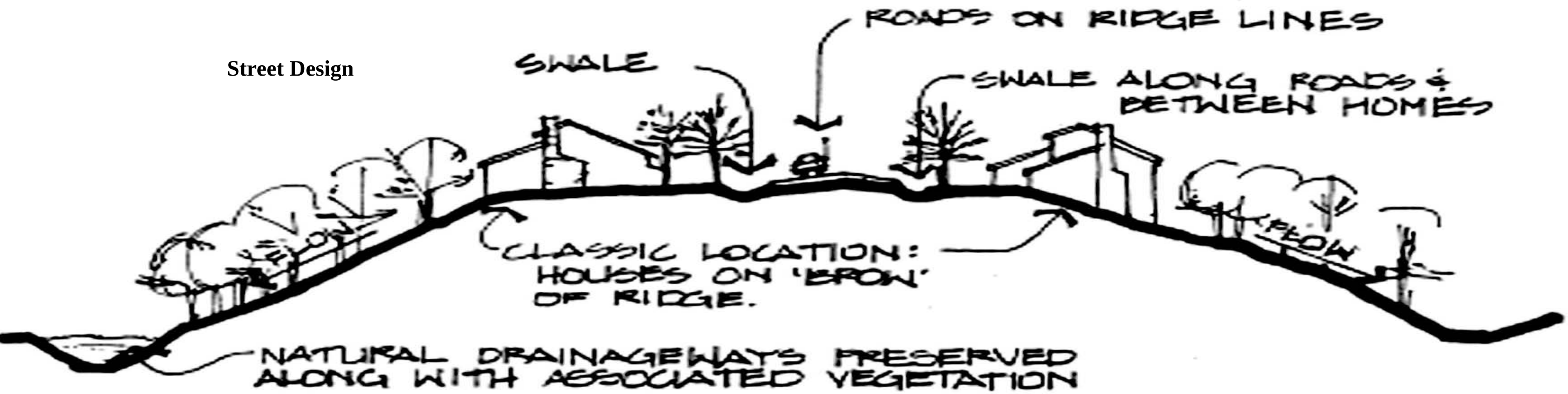
Bioretention Area Conceptual Layout
(functioning like an Infiltration Basin)



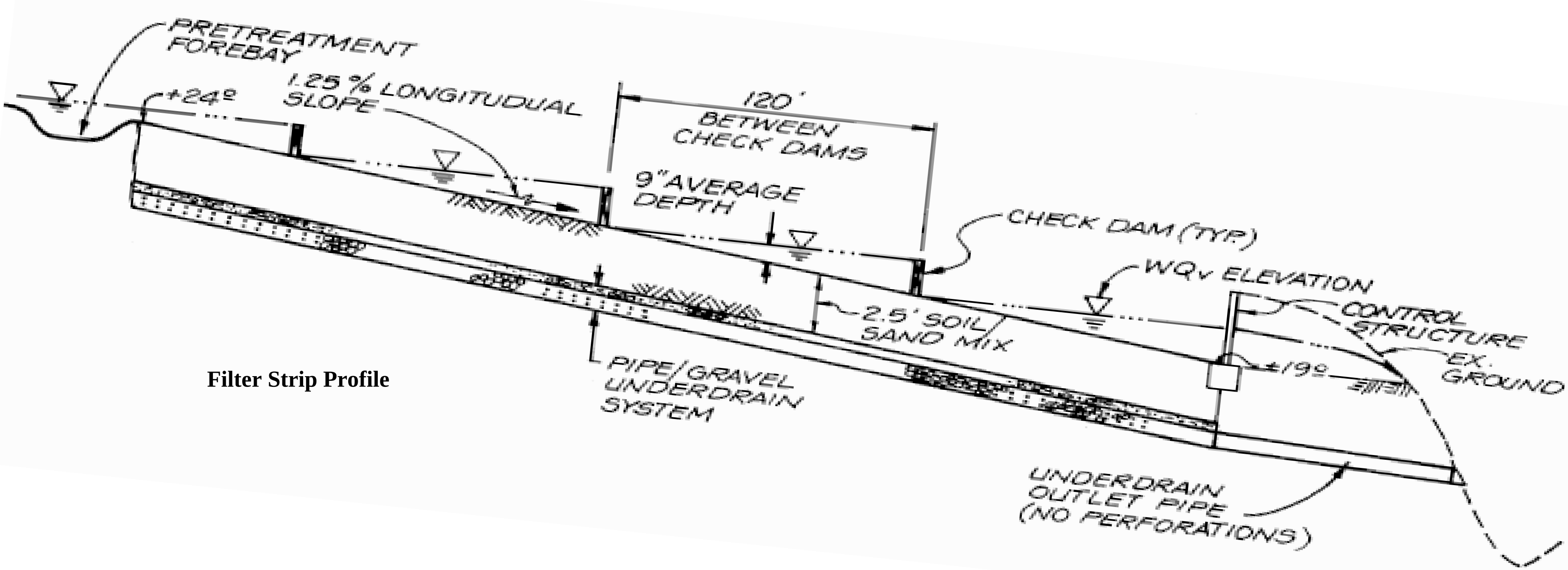


The Bioretention Concept

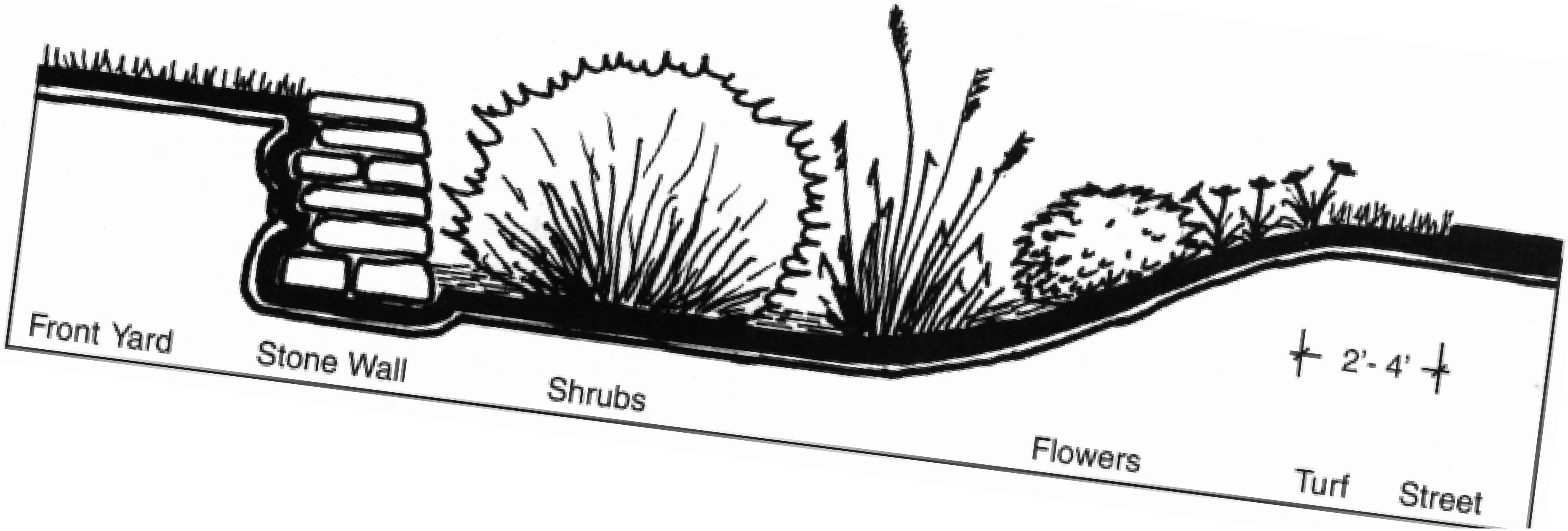
Street Design

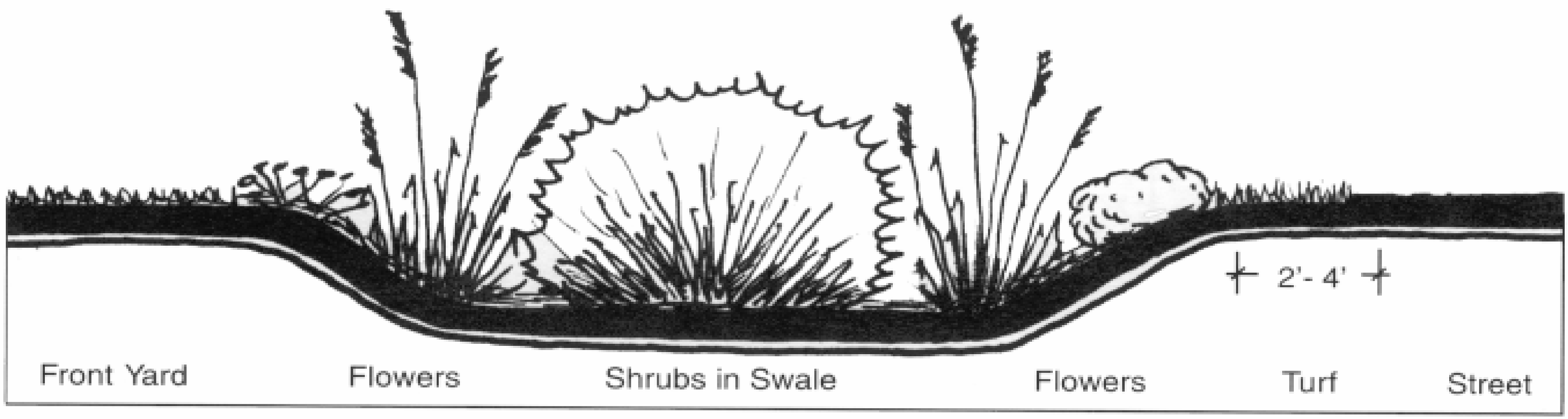


Filter Strip Profile



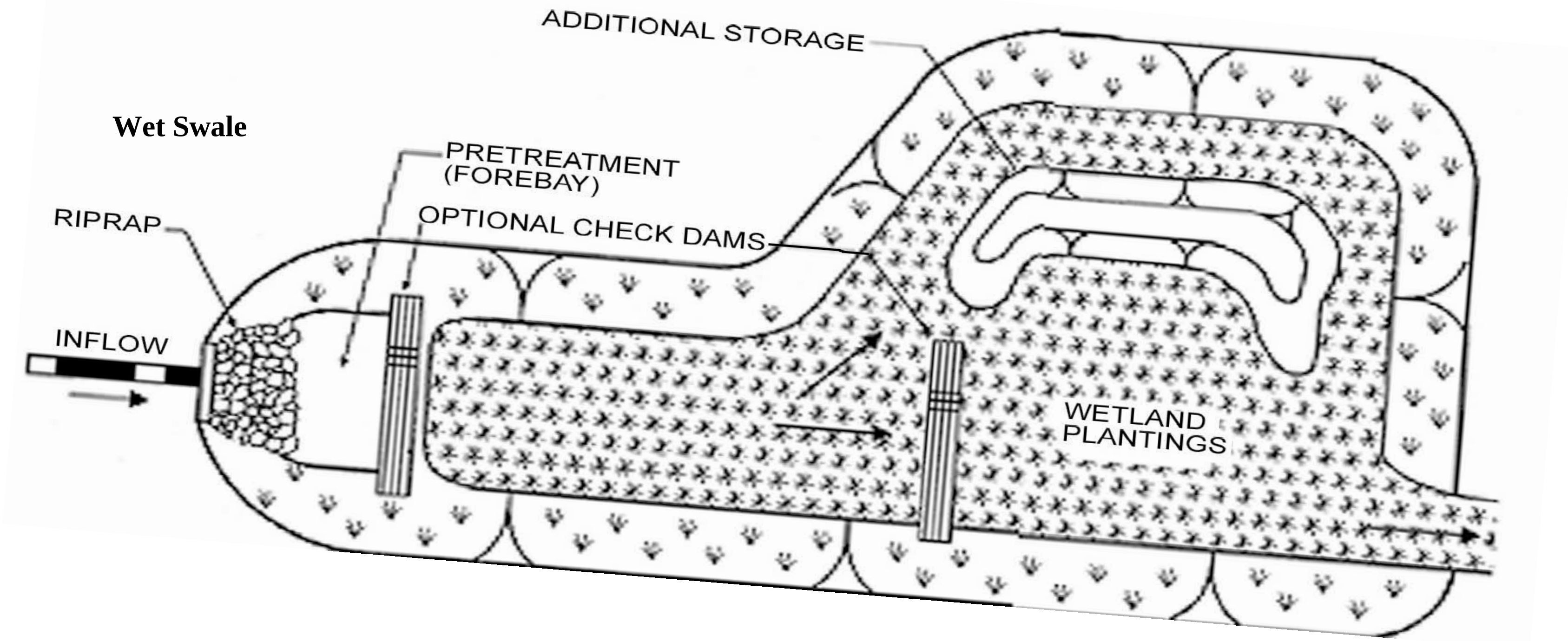
High Volume, Asymmetrical Rainwater Garden with Masonry Wall

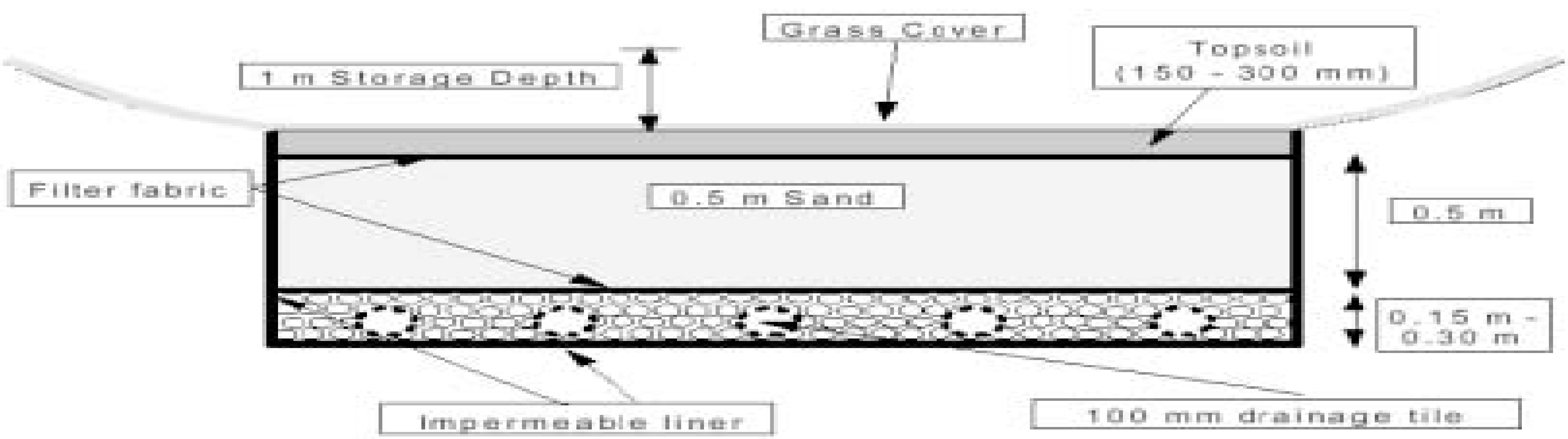




High Volume Symmetrical Rainwater Garden

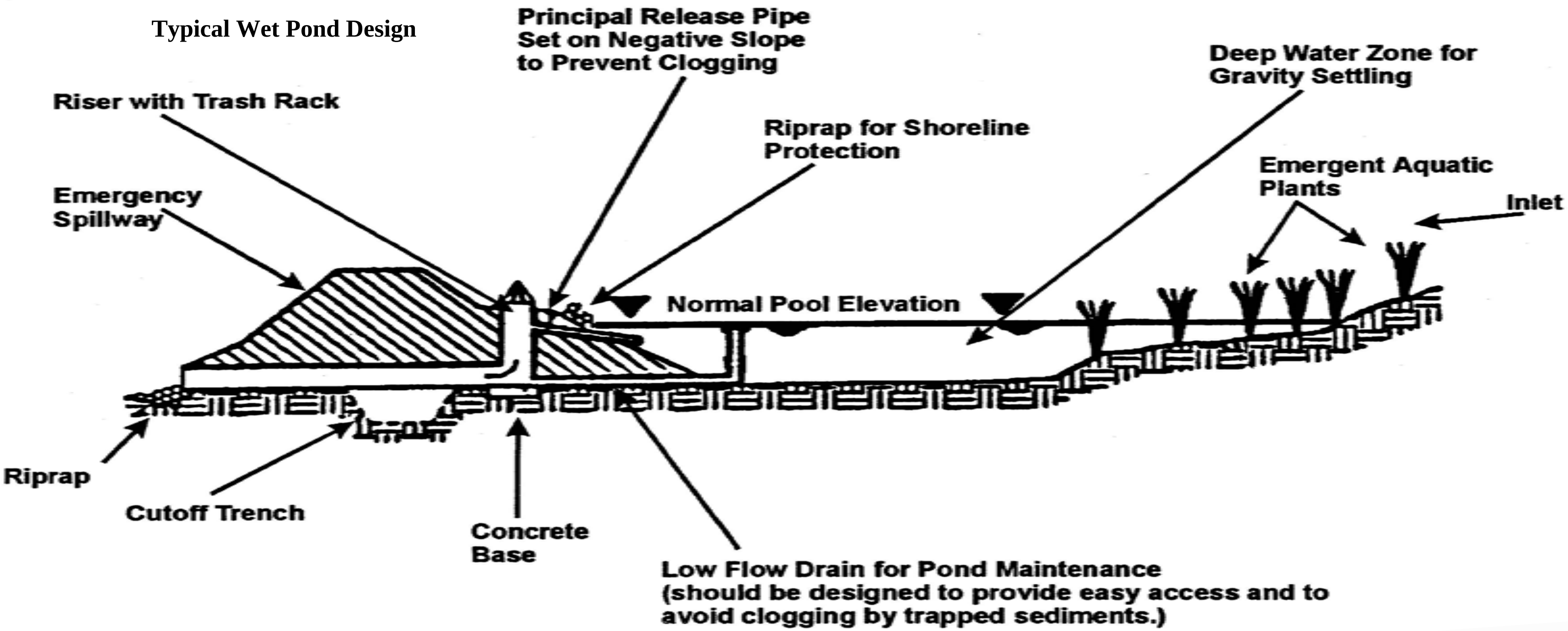
Wet Swale

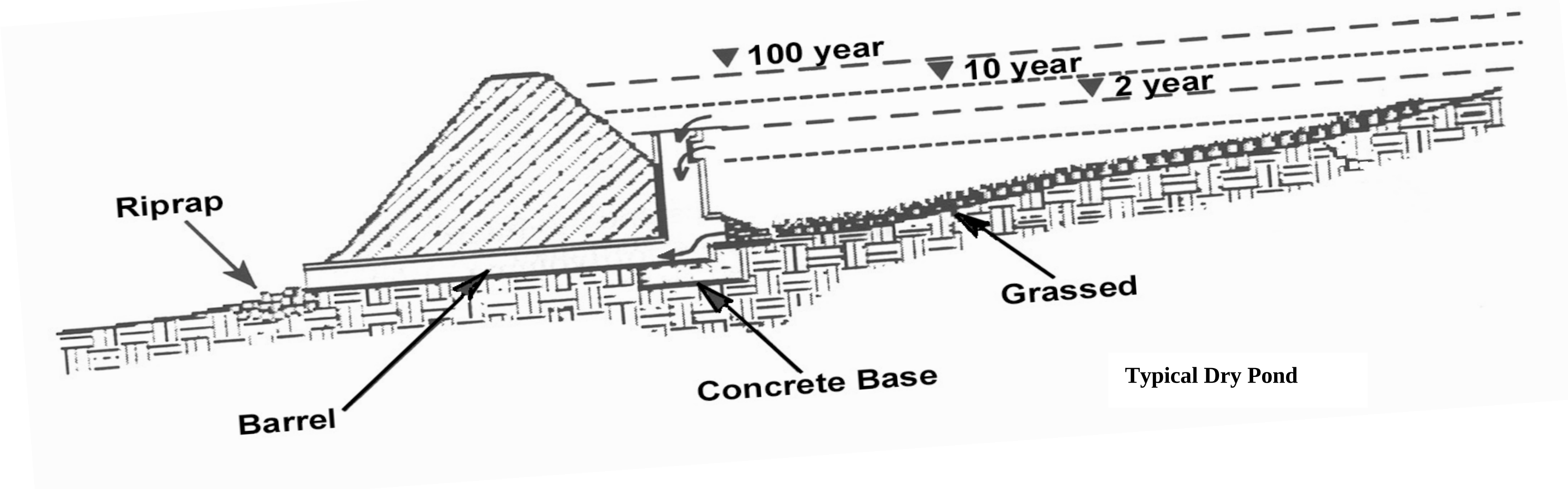




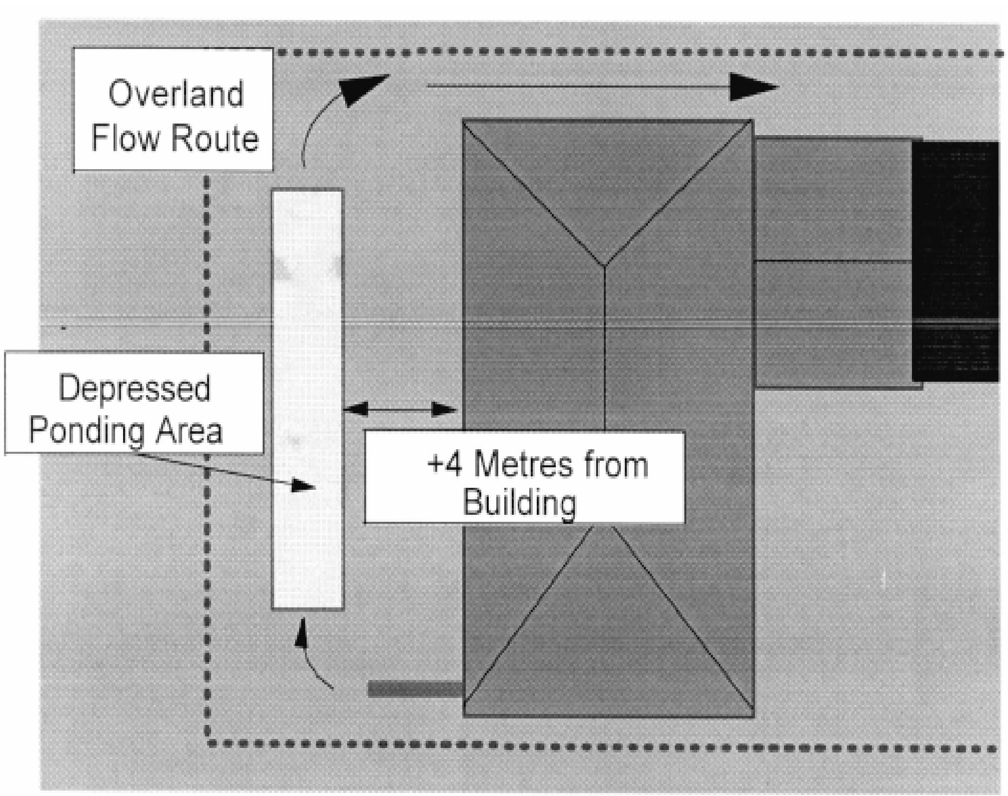
Sand Filter Cross Section

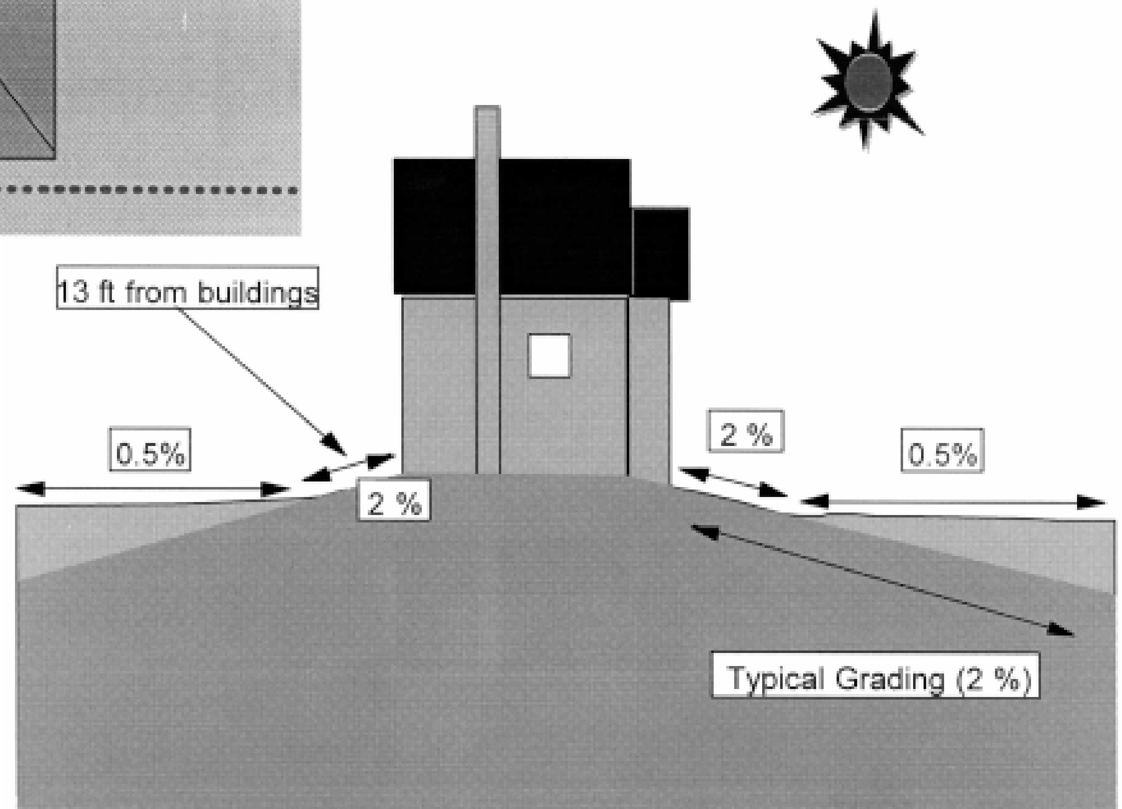
Typical Wet Pond Design





Typical Dry Pond





Example of Lot Grading changes

Tyler Coulee Watershed Master Plan

- What Will You Learn Tonight
  - Progress of two work groups
  - Master plan recommendations
  - Finance plan recommendations

Tyler Coulee Watershed Master Plan

Meeting Schedules

- **Master Plan Work Group**
  - May 27, 2004
  - July 8, 2004
  - August 5, 2004
  - September 16, 2004
  - November 1, 2004
- **Finance Work Group**
  - June 2, 2004
  - June 29, 2004
  - August 2, 2004
  - August 30, 2004
  - November 1, 2004

Tyler Coulee Watershed Master Plan

- Storm water master planning is intended to determine what new infrastructure is required to accommodate runoff generated by existing and future development

- Master Plan Project Elements
  - Local facilities
    - Lateral storm sewers
    - Smaller site specific detention facilities
  - Regional facilities
    - Trunk line storm sewers
    - Detention facilities
  - Development Control Line (DCL)
    - Floodplain and breach zone (Tier One - Prohibited)
    - Steep slopes and undevelopable property (Tier Two - Caution)
    - Public Hearing Review through plat review/approval process

Tyler Coulee Watershed Master Plan

- **Local Drainage Improvements**
  - Conveys runoff generated by properties directly contributing to the storm water system
  - Typically serves one or more developed or undeveloped areas
  - Connects to a regional storm water system
  - Benefits are mainly located upstream and/or along the storm water system

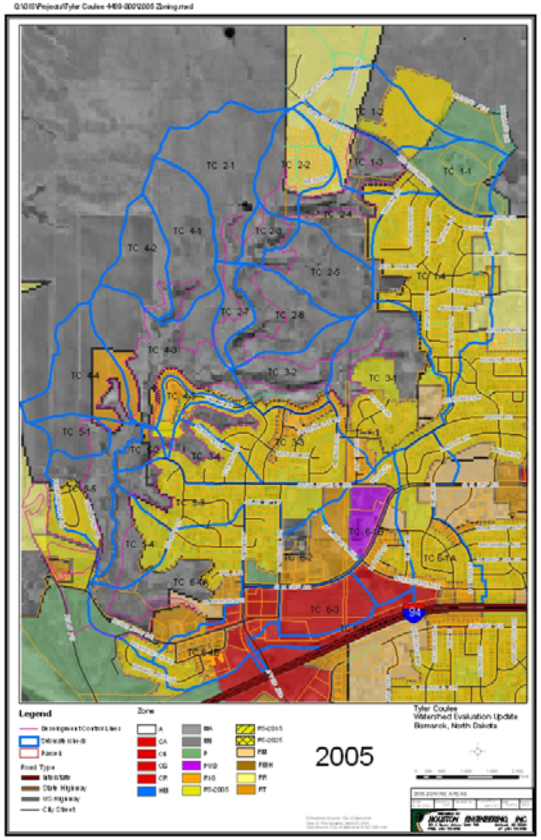
Tyler Coulee Watershed Master Plan

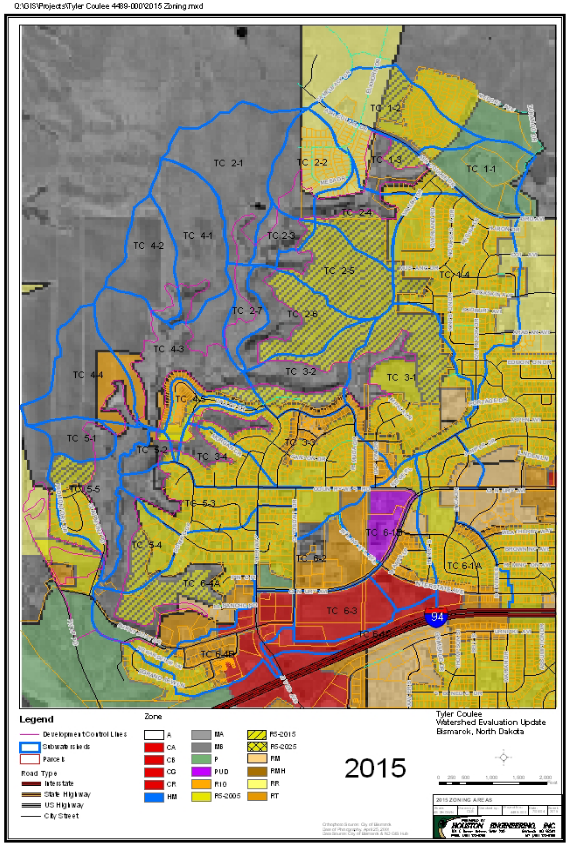
- **Regional Drainage Improvements**
  - Conveys runoff generated by properties directly or indirectly contributing to the storm water system
  - Typically collects storm water from local improvements
  - All properties within a watershed contribute/benefit from regional improvements
  - Benefits include storm water conveyance, flood damage reduction, reduced downstream infrastructure costs, environmental protection, water quality improvements and green space

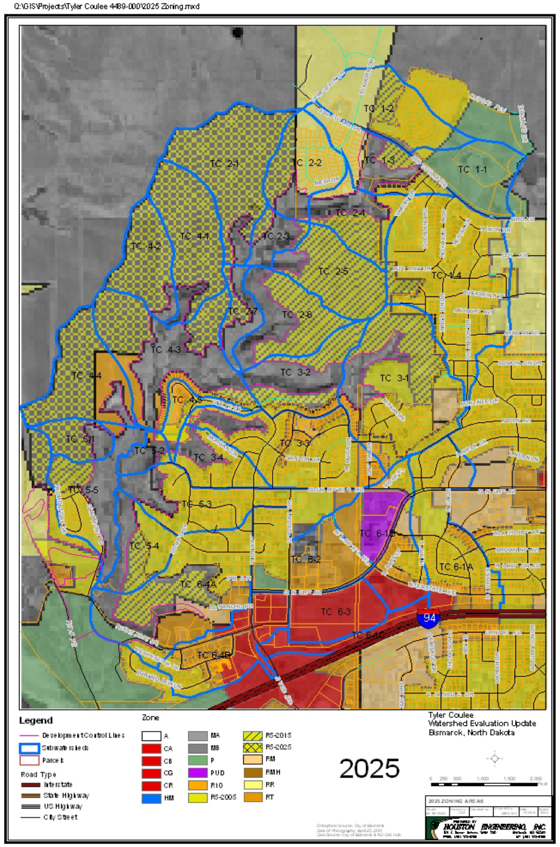
Tyler Coulee
Watershed Master Plan

- **Urbanization and Future Development**
- **Existing and Future Zoning**
- **Planning Horizon**
  - 2005 Today
  - 2015 Tomorrow
  - 2025 Full Development

Tyler Coulee Watershed Master Plan







Tyler Coulee Watershed Master Plan

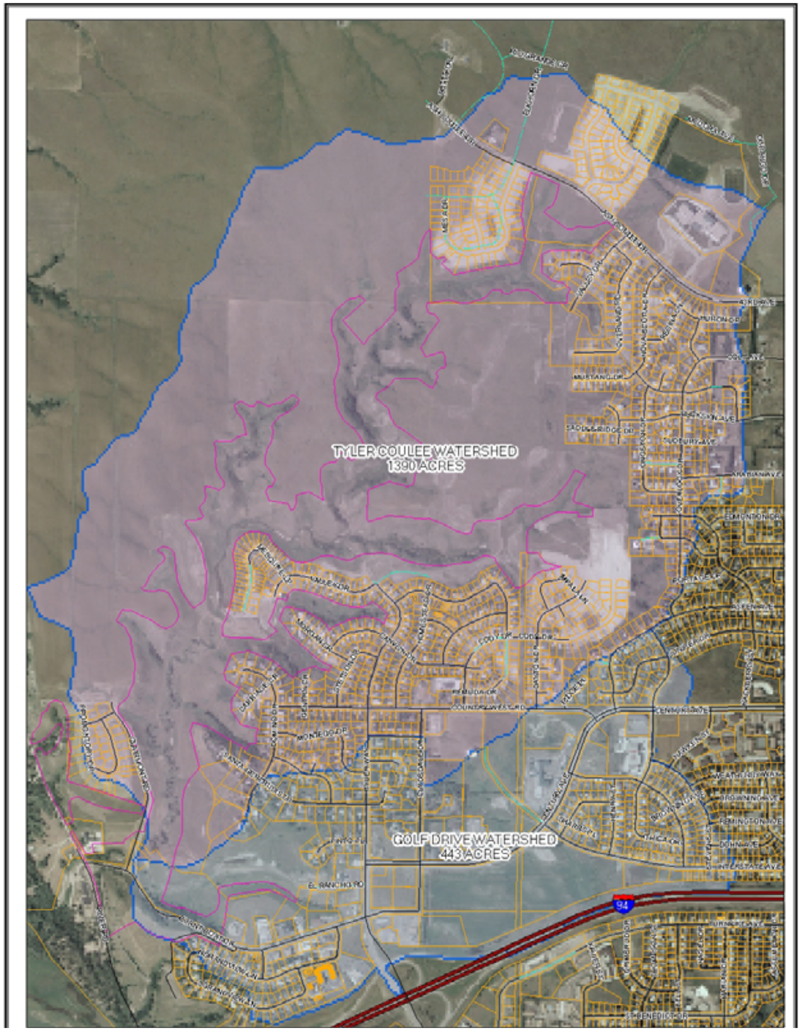
- **Regional Drainage Improvements (Tyler Coulee)**
  - Clairmont Road
  - Valley Drive Embankment
  - Tyler Parkway Embankment
  - Valley Drive East Embankment
  - Eagle Crest Embankment
  - Overland Road Embankment

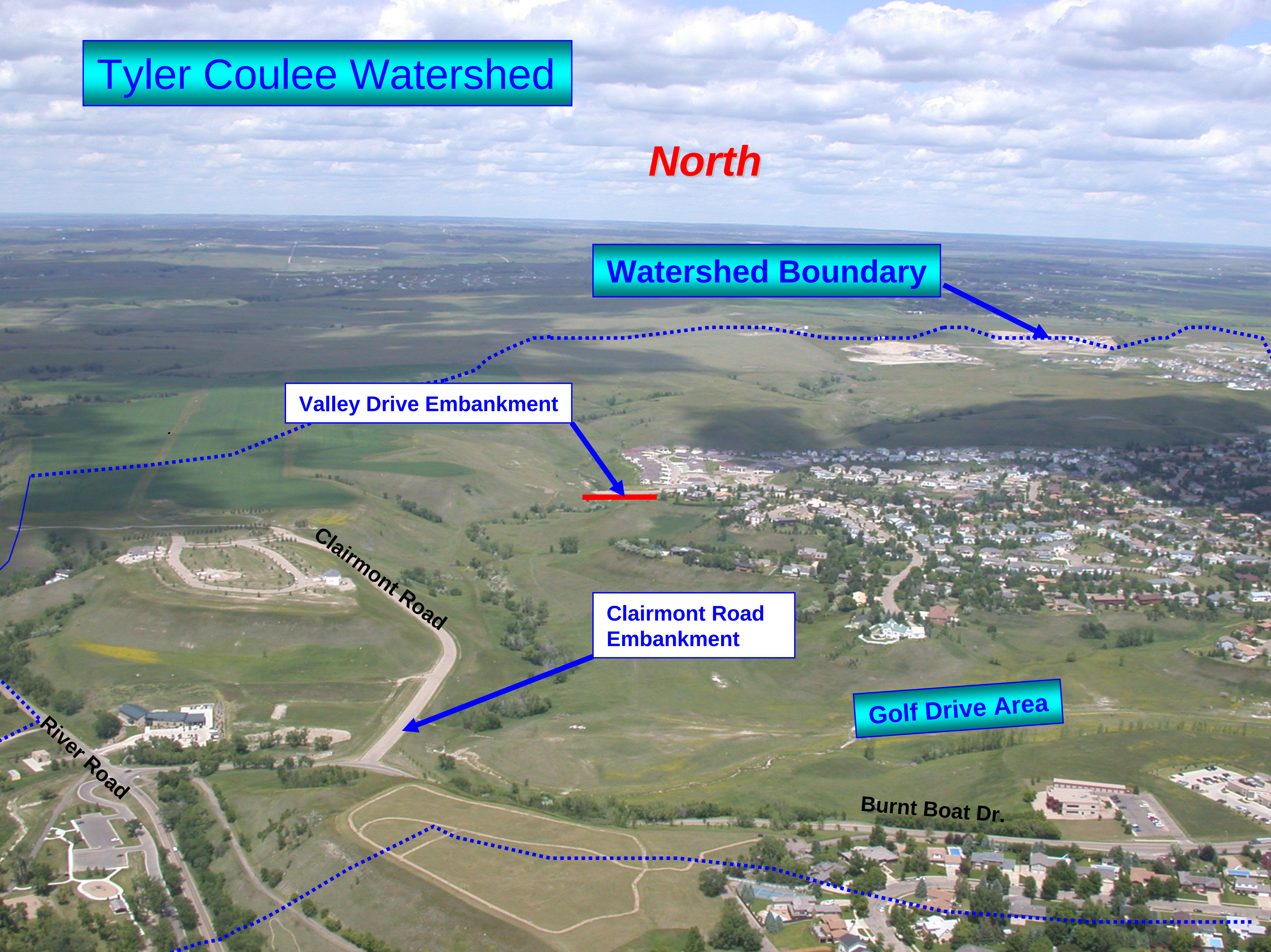
- **Regional Drainage Improvements (Golf Drive)**
  - Golf Drive Storm Water Drainage Corridor

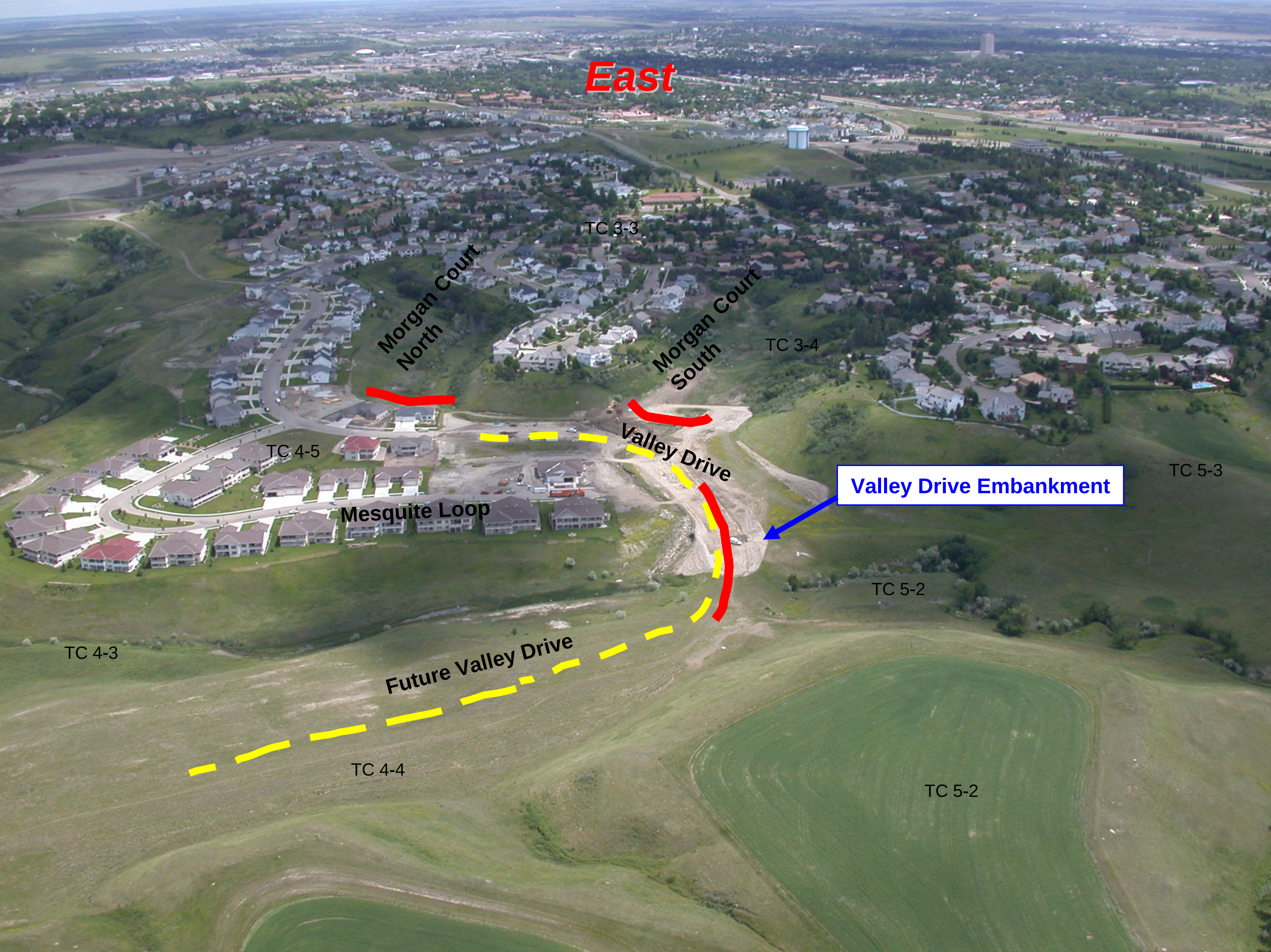
Tyler Coulee Watershed Master Plan

- **Tyler Coulee Watershed**
  1390 Acres

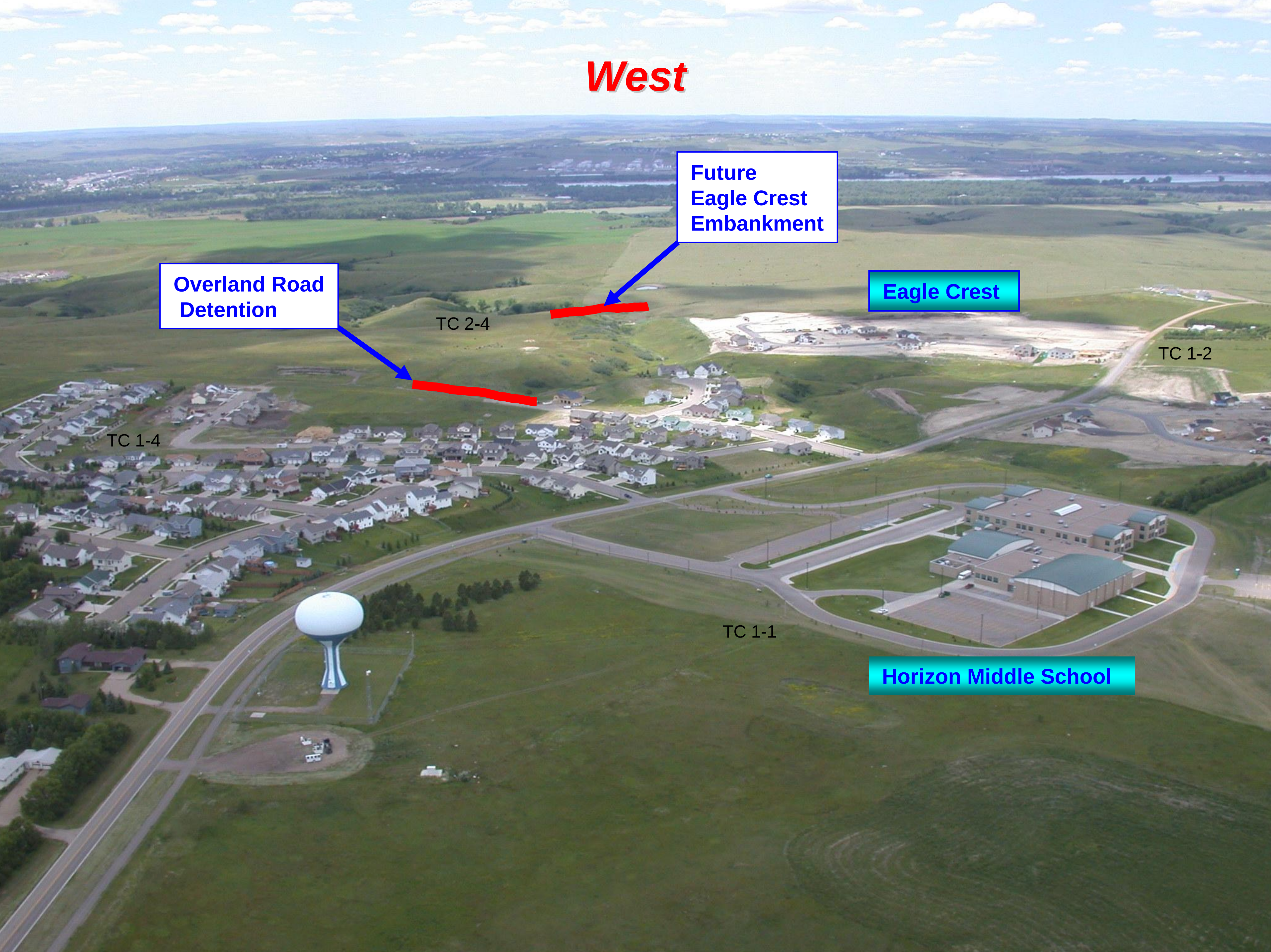
- **Golf Drive Watershed**
  443 Acres




Tyler Coulee Watershed
North
Watershed Boundary
Valley Drive Embankment
Clairmont Road
Clairmont Road Embankment
Golf Drive Area
River Road
Burnt Boat Dr.


East
TC 3-3
Morgan Court North
Morgan Court South
TC 3-4
TC 4-5
Valley Drive
Valley Drive Embankment
TC 5-3
Mesquite Loop
TC 5-2
TC 4-3
Future Valley Drive
TC 4-4
TC 5-2


East
TC 2-6
Valley Drive East Detention
TC 3-2
TC 2-7
Future Tyler Parkway
Future Tyler Parkway Embankment
TC 4-1
TC 4-3
TC 4-2
~ Development Control Line


West
Future
Eagle Crest
Embankment
Overland Road
Detention
Eagle Crest
TC 2-4
TC 1-2
TC 1-4
TC 1-1
Horizon Middle School

Tyler Coulee Watershed Master Plan

Development Control Line (DCL)

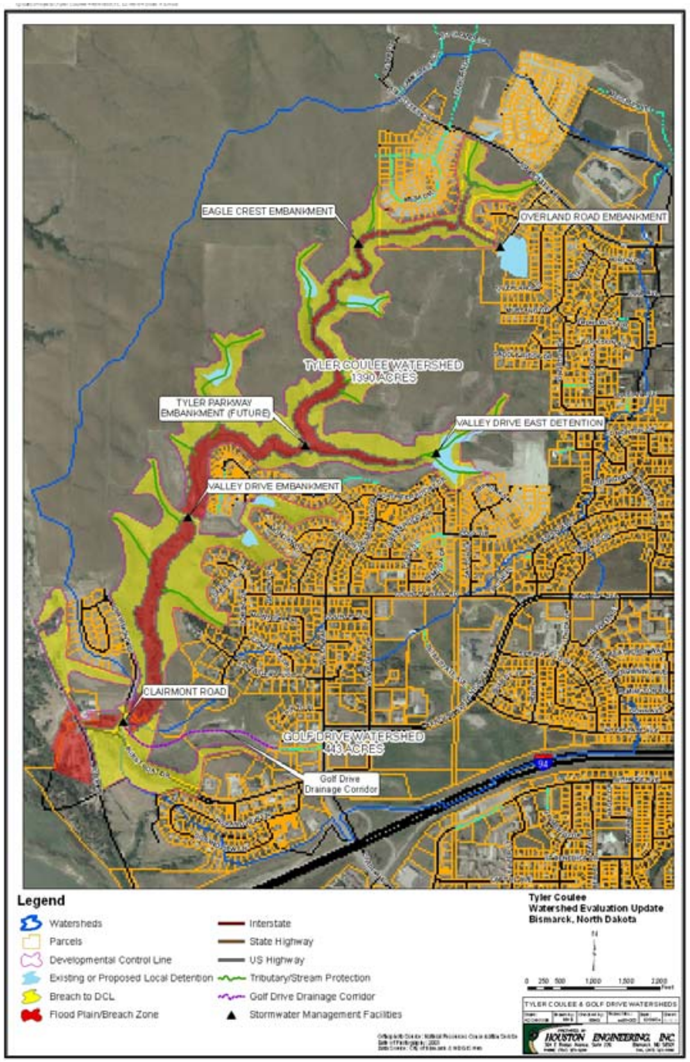
Tier One –

Floodplain/Breach Zone
(Development Prohibited)

Tier Two –

Development Restrictions

Additional Review Required



Tyler Coulee Watershed Master Plan

			Assessable Area			Cost Projection		
Tyler Coulee Watershed	Opinion of Probable Cost	Total Drainage Area (acres)	City Limits Platted Area (acres)	Undeveloped Property (acres)	DCL Area (acres)	Cost in City Limits (sq. ft.)	Undeveloped Property Cost (sq.ft.)	Old Method
Clairmont Road Valley Drive Tyler Parkway Valley Drive East Eagle Crest Overland Road								
Total	$2,700,000	1,390	572	520	298	$0.0757	$0.0757	$0.1445
						$1,414,338	$1,285,662	
Golf Drive Watershed	$780,000	443	383	41	19	$0.0563	$0.0539	$0.0624
Total Drainage Area =		1,833	955	561	318	$704,557	$75,443	

Total Regional Project Cost **$ 3,480,000**

Tyler Coulee
Watershed Master Plan

Funding Alternatives

- Local Drainage Improvements
  - Revised special assessment process
  - Storm water facility charge

Tyler Coulee
Watershed Master Plan

Funding Alternatives

- Regional Drainage Improvements
  - Revised special assessment process
  - Storm water facility charge
  - Storm water utility charge
  - Burleigh County Water Resource District (Special Assessments)

Tyler Coulee Watershed Master Plan

Funding Recommendations

- Local Drainage Improvements
  - To Be Determined

- Regional Drainage Improvements
  - Revised Special Assessment Process

Tyler Coulee Watershed Master Plan

Acknowledge the dedication of the two work groups

THANK YOU!

Tyler Coulee
Watershed Master Plan

Questions?

Burleigh County Water Resource District Assessment District Projects

- Authorities - North Dakota Century Code

NDCC 61-16.1 – Operation of Water Resource Districts

- 61-16.1-09 Powers of water resource board **(2 items)**
  - **Make rules and regulations concerning the management, control, regulation, and conservation of waters and prevent the pollution, contamination, or other misuse of the water resources, streams or bodies of water included within the district.**
  - **Plan, locate, relocate, construct, reconstruct, modify, extend, improve, operate, maintain, and repair sanitary and storm sewer systems, or combinations thereof, including sewage and water treatment plants, and regulate the quantity of sewage effluent discharged from municipal lagoons; and contract with the United States government, or any department or agency thereof, or any private or public corporation or limited liability company, the government of this state, or any department, agency, or political subdivision thereof, or any municipality or person with respect to such systems.**

NDCC 61-16.1-15

Financing project through revenue bonds, general taxes, or special assessments – Apportionment of Benefits

- **Project Initiation – Upon request or motion of the Board**
- **Project Revenue and Financing Sources**
  - **Improvement warrants**
  - **Special assessments**
  - **General taxes**
  - **Revenue Bonds**
- **Apportionment of Benefits**
  - **"…, such assessments shall be apportioned and spread upon lands or premises benefited by the project in proportion to and in accordance with benefits accruing thereto."**
  - **"In determining assessments the water resource board shall carry out to the maximum extent possible the water management policy of this chapter that the upstream landowners must share with the downstream landowners the responsibility to provide for the proper management of surface waters." (reference to NDCC 61-16.1-10)**

Project Development and Assessment Provisions

- **Adoption of Project Resolution (NDCC 61-16.1-17)**
  - Determination of necessity to construct and maintain
  - Engineering Report and Opinion of Probable Cost

- **Project Development Process**
  - **Public Hearing -** Project Information (purpose, costs, assessments, etc…) **(NDCC 61-16.1-18)**
  - **Voting Authority -** one vote for each $1 of assessment **(NDCC 61-16.1-20)**
    - 0% to 100% Assessments – as defined by the Board **(NDCC 61-16.1-21)**
    - If > 50% of the “votes filed” favor the project it proceeds **(NDCC 61-16.1-19)**
  - **Special Assessment List**
    - Public Hearing – Assessment List Objections/Adjustments **(NDCC 61-16.1-22)**
    - Appeal to State Engineer **(NDCC 61-16.1-23),** Requires 25% of total assessment votes
  - **Construction**
    - No contract can be awarded which exceeds 20% the estimated cost as presented and approved by the affected landowners. **(NDCC 61-16.1-24)**

NDCC 61-16.1-21
Assessment of cost of project

- "In determining benefits the board shall consider, among other factors, property values, degree of improvement, productivity, and the water management policy as expressed in Section 61-16.1-15."

- "Benefited property belonging to counties, cities, school districts, park districts, and townships shall not be exempt from such assessment and political subdivisions whose property is so assessed shall provide for the payment of such assessments, installments thereof, and interest thereon, by the levy of taxes according to law."

- "Any county, township, or city assessed in its corporate capacity for benefits received shall provide for the payment of such assessments, installments thereof, and interest thereon from its general fund or by levy of a general property tax against all the property therein in accordance with law."

NDCC 61-16.1-45 Maintenance Assessments

- Annual Maintenance Fee (as necessary)
  - Infrastructure (i.e., storm sewer, culverts, dams, etc…)
  - Green Space (i.e., mowing, spraying, erosion repair, etc…)
- Tyler Coulee Existing Conditions
  - ~ 1,160 platted lots
    - Maximum annual levy is $1.50 per $500 of taxable valuation
    - $ 26.25 per residence (~ $150,000 average assessed value)
    - $ 57.75 per acre (~ 2.2 residences/acre average from raw land)
  - ~ 1,040 acres of undeveloped land and green space
    - Maximum annual levy is $1.50 per acre
- Total Annual Revenue Potential **($30,450 + $1,560 = $31,010)**
  - Maximum Reserve = 4 years of maximum collection

NDCC 61-16.1-26 Reassessment of Benefits

- **Following Project Completion**
- **New development occurs changing value of benefits**
- **Reassessment can occur -**
  - **At any time or by petition of any affected landowner or political subdivision**
  - **Only after the first year**
  - **Public Hearing for those whose assessments are to be raised**
  - **Petition only once every 10 years**
  - **Provides the ability to redistribute costs and remaining debt as long as the ability to repay is not impaired**
  - **Bonding period varies**

Master Plan ~ Approximate Maintenance Assessments

- Anticipated Full Development
  - ~ 1,160 existing platted lots
  - ~ 1,540 potential for new lots **(average 2.2 per acre of raw land)**
  - ~ 2,700 total lots **(assuming all residential no commercial)**
    - **Developable Acreage = Total undeveloped – DCL – Streets**
      - **~ 15,000 square foot lots (loss of ~20% to streets)**
    - **$ 26.25 per residence**
- Green Space (i.e., City, Bismarck Parks & Rec., Private)
  - ~ 330 acres within Development Control Line (DCL)
- Total Annual Revenue Potential = $70,900
  - **Maximum Reserve = 4 years of maximum collection**

Burleigh County WRD
Revenue Sources and Expenses

- **General Revenue County Mill Levy = max @ 4 mills**
  - **1 mill is ~ $125,000**
- **Grant Funding and Cost Shares**
  - **North Dakota State Water Commission (State Engineer)**
  - **EPA Section 319 – Water Quality Projects**
  - **Others**
- **Expenditures**
  - **General Operations**
  - **McDowell Dam and Recreation Area**
  - **BOMMM Joint Water Resource Board**
  - **Burnt Creek Flood Control Project**
  - **Shared Projects – Engineering Studies and Investigations**
  - **City/County/Township Cost Shares – Small Projects**

Coulee's neighbors seek new funding program

12-4

By TONY SPILDE
Bismarck Tribune

Tired of paying what they considered to be more than their fair share, residents near Bismarck's Tyler Coulee have developed a plan that could change how some city water projects are funded.

Proposed changes include adding a fee — likely in the neighborhood of $1 — to everyone's city water bill.

The money would help fund drainage projects where there is new development on the edges of town. The plan would be a departure from the city's traditional method of strictly assessing special fees to property owners who benefit from the improvements.

The idea came about as engineers were developing a master plan for Tyler Coulee, which runs from Horizon Middle School to Pioneer Park in northwest Bismarck. Urban development increased the amount of runoff into the watershed, prompting the city to create a water-management plan there.

Residents in the area voiced concerns about paying multiple special assessments, saying they had to keep paying for every improvement, while people who build in the watershed later would be getting a free ride.

So, with help from the city, residents proposed a new payment plan that they say provides a more equitable distribution of costs.

In it, the city would act as a banker, paying for the cost of the watershed up front by using the money from every water user's bill. The city would get its money back by charging a one-time special assessment to the affected property owners. And, as developments in the area begin to fill in, those people would be charged the same "special" rate.

In the $3.8 million Tyler Coulee project, that would reduce the cost of specials from about 17 cents a square foot to about nine cents.

"They made a convincing argument to us that (the current method) wasn't fair," said Keith Demke, Bismarck's director of utility operations.

Demke said concerns by residents whose water bill would go up — and who wouldn't directly benefit from a water project — are well-founded.

"We'll have to convince them that it's for the overall good of the community,"

WATER: *Continued on Page 14A*

Water: Public information meeting Monday

FROM 1A

Demke said. "This funding mechanism allows us to get around an impediment to growth. Hopefully everyone benefits by the city growing."

There will be a public information meeting about the funding plan and the Tyler Coulee Master Plan at 6 p.m. Monday in the Horizon Middle School Cafetorium.

Demke said the issue will be put to city commissioners at their Dec. 14 meeting.

Information on the project also is available online, at www.bismarck.org. Click the "I want information on ..." button, and scroll down to the Tyler Coulee link.

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Watershed finance plan moves ahead

By GORDON WEIXEL
Bismarck Tribune

A plan to finance the Tyler Coulee watershed projects may impact the community of Bismarck and future development if the Bismarck City Commission acts on recommendations to be made at its Dec. 14 meeting.

Monday night, about 60 residents gathered at Horizon Middle School in north Bismarck to get an update on the Tyler Coulee Watershed Master Plan. City Commissioner Connie Sprynczynatyk led the presentation, which was followed by an in-depth question-and-answer period.

Sprynczynatyk detailed how at an April meeting, residents impacted by the watershed development projects costing an estimated $4.1 million, asked that alternate means be found to help cover the cost. Two task forces were created from the initial meeting, one to focus on the master plan development and the other on financing.

Out of the master plan group, a two-tier development control line was proposed for the 1,137-acre watershed. Tier One featured areas where development will be prohibited and Tier Two where development restrictions will be place, left to the review of the city. The burden to develop in Tier Two, where development is considered unreasonable, will be placed upon the developer.

A second task force looked at several ways to come up with a palatable way of paying for projects, which will be built as development of the Tyler

WATERSHED: *Continued on Page 2B*

Watershed: Plan involved $1 hike in local water bills

FROM 1B:

Coulee watershed requires. The task force concentrated on finding ways to include property in the assessments, which are within the watershed, but outside city limits.

The plan they came up with involves a $1 increase in storm water utilities being charged Bismarck's residential and commercial properties.

This money will be placed in a fund that will be used to finance the water development projects as they are needed. As areas outside city limits are developed and annexed into Bismarck, property owners will be assessed for the development projects, with the assessment being placed in the watershed development fund.

"We needed to come up with a process that not only address the Tyler Coulee situation, but other watersheds with similar concerns," Sprynczynatyk said.

Houston Engineering's Mike Gunsch said the details of the Tyler Coulee master plan probably wouldn't be completed until after the holidays.

Keith Demke, the city's director of utility operations, said it's important the financing plan generate enough money, but not too much. He envisions an annual review of the charge, which will be dedicated to storm water development projects.

"This is not a perfect solution, but I feel it is reasonable," Demke said.

Demke feels the additional $1 on utility bills is justified for those outside the Tyler Coulee watershed, because of the city development it promotes.

Those attending the meeting did encourage the Tyler Coulee committee to present an addition to the finance plan to the Bismarck City Commission that requires developers to pay an upfront fee toward watershed projects. Those attending also approved of placing a sunset clause on the $1 utility fee in hopes of eventually using the city sales tax for the watershed fund.

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Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX C

Citizen Work Groups
and
Supporting Documentation

Citizen Work Group Participants

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
Ken Royse, Chairman
City/County Office Building
221 North 5th Street
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 both local and community interests.

- Craig Bleth
- David Bliss
- Mark Bohrer
- Fay Connell
- Gene Duchsherer
- Brian Eiseman
- Bob Entringer
- Robert Fischer
- Kyle Forster
- Al Frank
- Carolyn Frank
- Lowell Fruhwirth
- Gilberto Gonzalez
- Mark Gonzalez
- Kent Hauge
- Rodney Hoff
- Kevin Holm
- Scott Hopfauf
- Bill Huether
- Don Jensen
- George Keiser
- Fred Kraft
- Les Larson
- Paul Maddock
- Harvey Melstad
- Kelly Moldenhauer
- Ed Murphy
- Larry Nieters
- Scott Olson
- Chad Orn
- Jason Petryszyn
- Art Rhode
- Scott Rising
- Lon Romsaas
- Dennis Sailer
- June Skuza
- Donna Schauer
- Robert Schauer
- Steve Smokey
- 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.

Bismarck

Tyler Coulee

Storm Water Master Plan
City of Bismarck

APPENDIX C - 1

Master Plan Work Group

Meeting Summaries

May 27, 2004
July 8, 2004
August 5, 2004
September 16, 2004
November 1, 2004

Tyler Coulee Storm Water Master Plan Work Group
May 27, 2004
7-9 p.m.
Public Works Building
Meeting Summary

Attending:
Citizens:
Gilberto Gonzalez, Kevin Willis, Kyle Forester, Les Larson, Bill Huether, Chard Orn, Carolyn Frank, Brian Eiseman, Ed Murphy, Al Frank, Jason Petryszyn, Larry Nieters, Scott Rising, Dennis Sailer, Craig Bleth, Kevin Thomas, Scott Hopfauf, Kevin Holm, Paul Maddock, Mark Gonzalez

City of Bismarck:
Keith Demke, Director of Utility Operations; Mel Bullinger, City Engineer; Lisa Ansley, Project Engineer;

Houston Engineering:
Michael Gunsch

Keith Demke called the meeting to order at 7:05 p.m.

Keith Demke provided background on the existing master plan that was completed in 2002 for the Tyler Coulee Watershed. The project was funded by a Section 319 EPA grant as well as local contributions from the City of Bismarck, Bismarck Parks and Recreation District, Burleigh County Water Resource District, North Dakota Department of Transportation, Ducks Unlimited and C-Family Trust. The purpose of the master plan was to develop a hydraulic/hydrologic model to identify the "big picture" issues within the watershed. The master plan involved rainfall and flow measurements, as well as water quality monitoring, however, due to limited rainfall and runoff events during the 18 month study limited data available to make solid recommendations. A copy of the 2002 master plan will be made available on the City of Bismarck web page (www.bismarck.org).

Keith Demke explained that the 2002 master plan did not provide the level of detail that is necessary to address specific development questions. In 2003 the City selected Houston Engineering, Inc. to complete a detailed master plan for Tyler Coulee. One major issue that has changed since the 2002 master plan is the involvement by the North Dakota State Engineer in storm water facilities which store greater than 25 acres feet of water. The State Engineer will now be taking jurisdiction of these facilities and requiring that these be designed and built to meet certain safety standards. The new requirements will significantly change the design of these facilities.

Michael Gunsch provided the group with a handout of the current work that is ongoing with the master plan. A copy of the handout is attached as Exhibit A. Each slide was discussed in detail.

The group discussed the regional facilities that have been identified. Some questions discussed included:

- Can more small detention the detention facilities be constructed so as to not require that they be constructed to the State Engineer “Dam Safety Standards”?
- Does permanent storage of water (retention) provide value to adjacent property?
- Does the developer have a responsibility to disclose future storm water requirements to future home owners?
- When are the regional facilities needed?
- Who decides when lands are developed?

The definition of regional facilities will be critical for the finance committee. This definition will be important for all future storm water master plans. The group agreed that there are clear cut projects that definitely fall into the regional facility, however, a definition must be established to allow the determination of facilities that are not as obvious.

The group discussed the criteria for the establishment of the “Development Control Line” (DCL). Several preliminary criteria were discussed and are included in the handout attached. The group agreed that a more defined list of criteria should be developed for the next meeting so that the group can review the items. The need to be flexible on the location of this line is important, however, there needs to be a policy on how the line can be moved.

The group discussed the need for including greenspace in the master plan. Some participants would like to see this included as they believe that the requirement for greenspace may actually decrease the need for some storm sewer. Others in the group were not in support of incorporating greenspace requirements with storm water requirements.

The next meeting date was set for August 5, 2004 at 7:00 p.m. at the Public Works Building.

Tyler Coulee Watershed Master Plan

Summary of Comments received after May 27, 2004 Meeting

1. What does the committee feel is a reasonable alternative approach?

A) I'm not quite sure what you are asking. I have yet to hear sufficient justification for any additional improvements beyond that already required of each development. To me there doesn't appear to be a problem except for the lack of adequate enforcement of erosion control measures taken by developers. The watershed appears to be sufficiently vegetated and meandered to handle storm events. There doesn't appear to be any major improvements in the Pioneer Park area, which is evidently the city's biggest concern. My feeling is that there is a good reason why that area is a park and not developed, and it should be expected to be affected for brief periods during major storm events. I have serious concerns about the load that current homeowners are being handed when the city and developers are bearing limited responsibility - particularly those areas of the watershed currently located outside of city limits. I also have concerns that the city is finally starting to work on a stormwater plan because the new Kohls development will have a big impact on the watershed. Again, what responsibility should developers bear - in my opinion, far more than the city is currently asking.

There's no reason why a good engineering firm cannot develop the necessary parameters and criteria for protecting the watershed ahead of the development. In this case, the best approach would be for the city to bear the cost of up front watershed protection, and assessing developers as they develop parts of the watershed. The city can limit its cost liability by establishing development control areas within each subwatershed as warranted.

B) Develop a master plan that carries runoff projections without further development. I suggest that when future development is approved that source of water runoff would be responsible for updating the system to handle the extra runoff. To me this is the only fair approach under current law where the city cannot access land outside the city. If the city cannot access land outside the city that contributes to the runoff then the city should not design a system to handle such runoff water.

C) Developers have to understand that they can not develop every acre of land. A DCL should be established an enforced. Subwatershed areas should be established and both the homeowners and the developer should pay on an acreage basis.

D) Other than for controlling the speed of the runoff, I would like to see the natural water channels preserved. I recognize that temporary impoundments will be necessary within regions and the water channels and that will be the minimalist approach. The development of artificial channels would be unacceptable and a last resort.

E) Development restrictions, local detention facilities

F) I think the master plan should consider that all developable land in the watershed will be developed. All subwatershed water management features should be in the master plan. Obviously low density development would reduce the water problems, but I don't know on what basis the density of houses can be specified by the city.

2. What is your opinion on establishing a Development Control Line (DCL) and where should it be located?

A) I believe that 2 types of DCL should be considered. As discussed at our last meeting, the first DCL should be established on either side of the main coulee draws as well as any lowland sites with potential flooding potential. This DCL would most probably run along the outside edges of the 30-40% sloped areas along the drainage.

I also believe a second set of DCLs should be considered, perhaps better described as development control 'areas' within each subwatershed. Since obviously the many parts make up the whole, limiting development in at least part of each subwatershed could contribute to conservation of water and reduce downstream impacts during storm events. As an example, looking at subwatershed TC3-1, the area between Saddle Ridge Road and the latest K&L additions, which is currently native pasture, would be restricted from development to provide natural water retention in the subwatershed, as well as needed green space that helps to maintain high property values (and the taxes on those properties).

B) It is imperative that DCL be established based on topography and location of water structures in respect to building sites. All water control structures should be located for efficiency of controlling water flow and NEVER for accommodating building sites, UNLESS the extra cost of locating structure for enhancing building sites are solely the responsibility of the developer.

C) I feel a DCL should be established because it lets everyone know where the potential problem areas are. It would have been better to have established it pre-development but the longer it goes the more problems will occur.

D) Establishment of a DCL is a good first step. The DCL should be based on the maximum development of the watershed, probable placement of impoundment structures and the effects on residences or businesses placed near the impoundment structures.

E) Some sort of DCL is a must, although there should be an avenue to move this line if the developer can implement a plan to maintain runoff at an acceptable level.

F) A DCL should be established. The natural drainage configuration should be as undisturbed as possible. A DCL on the basis of side slope or drainage slope alone would be difficult, since slope varies from less than 20% to greater than 40% on side slopes (and less than 10% on the coulee itself). A standard width around the drainage should be selected based on good engineering practice, knowing that in some areas where slopes are flat the DCL will need to be wider. The width of the DCL should consider enhancement features such as bike paths, etc.

3. What types of facilities are preferable, regional, local, natural, etc….

A) Natural facilities, such as conservation areas in each subwatershed described above, are my preferred choice. Beyond that, local, i.e. subwatershed level, retention facilities would be my second choice.

B) Master plan should utilize natural features to the extent possible, i.e. moving large amounts of earth and extensive shaping beyond the needs to efficiently control water flows should be avoided.

C) Natural whenever possible. This may require more of a setback than the others which would mean the developer would ultimately pay rather than the taxpayers of the city. Otherwise, the taxpayers are ultimately footing the bill so the developer can make more money.

D) Control runoff based on the maintenance of the natural watercourses utilizing regional control.

E) Natural and Local

F) Natural conditions are preferred. Some areas will require protective enhancements due to problems that have already developed. A "fake" canal-type look should be avoided. I think subwatersheds should be required to provide their own drainage control. I envision a master plan that includes necessary features on Tyler Coulee itself that are fixed in stone. As the subwatersheds are developed, their impact on the Coulee would already have been considered, and they would have no detrimental effect on the main drainage. In other words, the common structures downstream would already be of sufficient size to handle new subdivisions.

4. What should the alternatives focus on?

A) Alternatives should focus on the greatest effectiveness for the lowest cost, with the preservation of natural areas kept as a high priority.

B) Not to burden the homeowners impacted and not over design, i.e. why design for a 500 year event, when we really don't know what a 500 year event is?

C) What are the alternatives?

D) Location, cost and looks

E) Natural conditions are preferred. Public access is preferred. A green belt keeping development behind a control line is preferred. Some type of dry dam would be preferred to reduce mosquito problems - avoid holding water long-term.

5. What are the critical issues to address when developing alternatives?

A) (1) The level of expected development; (2) the cost to adequately address stormwater mgmt; (3) the preservation of natural areas within each subwatershed.

B) Due to the nature of the topography in the watershed rater detailed DCL are needed.
Plan for green space, but cost of developing green space should not be borne solely by those within the watershed. Green space is parks etc, so the city wide should pay the cost. Green space should not be only areas that are not suitable for residential or commercial development, but areas that can be developed into very attractive parks. The Master Plan should be designed to efficiently control water flow and not to accommodate the developers, i.e. design feature to accommodate future development should not be the cost responsibility of those now in a watershed, but to that of the future development

C) I do not want to see the creation of concrete-lined channels. In my opinion, the runoff rate can be controlled to maintain a green zone. Maximum development of a watershed, every square foot, is not desirable.

D) Effectiveness and cost

E) Avoid repetitive assessments. Hold contractor's liable for cleanup of deposited suspended solids. Enforce stormwater pollution/permitting standards. Keep the area as natural as possible with public access. A nice area to walk that's not next to a busy highway enhances the quality of life and will help mute opposition to the process (partly).

General Comment

I am unclear what alternatives we were given to choose from, and an alternative to what? Concerning the establishment of the DCL I thought the floodplain, flood fringes, or floodways FEMA controlled that? Does the city have a Zero Build Line policy or something like that? If strict conformance to the current city zoning rules be enforced, would that help in the control which areas get developed and how. This may require more long term planning for development.

Tyler Coulee Storm Water Master Plan Work Group
July 8, 2004
7-9 p.m.
Public Works Building
Meeting Summary

Attending:
Citizens:
Kevin Willis, Kyle Forester, Les Larson, Chard Orn, Ed Murphy, Al Frank, Dennis Sailer, Craig Bleth, Kevin Thomas, Paul Maddock, June Skuza, and Fay Connell

City of Bismarck:
Keith Demke, Director of Utility Operations; Mel Bullinger, City Engineer and Lisa Ansley, Project Engineer

Houston Engineering:
Michael Gunsch

Keith Demke called the meeting to order at 7:00 p.m.

Keith Demke provided background on the progress of the finance work group. The group is looking to find a realistic and equitable way to finance future storm water projects. A copy of the financing matrix that has been developed was distributed and is also available on the City of Bismarck web page at www.bismarck.org. Keith Demke stated that the main objective of the finance work group is to develop a funding recommendation that will spread the costs of storm water improvements to all contributing properties regardless of whether they are located in or out of the city limits. Some concern was expressed by the group that there must be a way for adjusting for inflation if the current process of equalization continues. (If a property pays $0.10/sq in 1990 that is not the same as $0.10/sq in 2004.) The finance work group will be meeting again on August 2, 2004 and will review a proposed "layered" funding alternative.

Keith Demke handed out a copy of the summary of comments from the May 27, 2004 meeting (see attached information). A summary of the comments was prepared by Michael Gunsch as follows "Preference is to retain natural (i.e., undevelopable) areas and aesthetics, and define these utilizing a flexible Development Control Line (DCL). **Regional** storm water facilities should be provided using the least expensive alternative focusing on an equitable cost distribution. **Local** storm water facilities should be funded directly by the developer(s) and/or specific development(s)."

Michael Gunsch provided a handout to summarize the progress that has been made on the master plan since the first meeting (see attached information).

An aerial flyover of the Tyler Coulee watershed was reviewed along with several photos of the watershed from different perspectives. The photos are available on the web site within the Tyler Coulee hot topic section.

The group discussed the regional facilities that have been identified. Some questions discussed included:

- Can more small detention the detention facilities be constructed so as to not require that they be constructed to the State Engineer "Dam Safety Standards"?
- Does permanent storage of water (retention) provide value to adjacent property?
- Does the developer have a responsibility to disclose future storm water requirements to future home owners?
- When are the regional facilities needed?
- Who decides when lands are developed?

The definition of regional facilities will be critical for the finance committee. This definition will be important for all future storm water master plans. The group agreed that there are clear cut projects that definitely fall into the regional facility, however, a definition must be established to allow the determination of facilities that are not as obvious.

The group discussed the criteria for the establishment of the "Development Control Line" (DCL). Several preliminary criteria were discussed and are included in the handout attached. The group agreed that a more defined list of criteria should be developed for the next meeting so that the group can review the items. The need to be flexible on the location of this line is important, however, there needs to be a policy on how the line can be moved.

The group discussed the need for including greenspace in the master plan. Some participants would like to see this included as they believe that the requirement for greenspace may actually decrease the need for some storm sewer. Others in the group were not in support of incorporating greenspace requirements with storm water requirements.

The next meeting date was set for August 5, 2004 at 7:00 p.m. at the Public Works Building.

TYLER COULEE MASTER PLAN
ALTERNATIVES WORK GROUP MEETING
JULY 8, 2004

REVIEW AND UPDATES

Prior Meeting Action Items
- June 2nd and June 29th Finance Work Group Meetings
- July 2002 Master Plan Report in PDF format on web site
- Tyler Coulee Watershed Breakdown (**See Page 5**)

Aerial Video and Photo Handout
Comments to four questions – response

Summary of Comments (HEI)

Preference is to retain natural (i.e., undevelopable) areas and aesthetics, and define these utilizing a flexible **DCL**. **Regional** storm water facilities should be provided using the least expensive alternative focusing on an equitable cost distribution. **Local** storm water facilities should be funded directly by the developer(s) and/or specific development(s).

UPDATE ON MASTER PLAN PROCESS

See Page 4

ALTERNATIVE DEVELOPMENT

SWMM Hydrologic Models - Updates

Existing Conditions	2005
Interim Development	2015
Ultimate Development	2025

Objective: Develop an alternative to accommodate existing conditions while remaining flexible to accommodate master plan development.

Method: Create adequate regional detention to handle existing and future storm water runoff conditions. Require new development to accommodate additional runoff in local detention and/or control facilities so as not to adversely impact regional facilities or the designated DCL area.

Regional Project Alternative Assumptions:

Existing Conditions 2005 See Existing Zoning Map

Existing storm water facilities and approved plats fully developed

Interim Development 2015 See Interim Zoning Map

Existing Facilities with new construction and/or modifications to:

Valley Drive Embankment and/or Tyler Parkway Embankment
Overland Road Embankment
Valley Drive East Embankment

Development along the east side of Tyler Coulee

Local Facilities – not included (PMP Design)

Ultimate Development 2025 See Master Plan Zoning Map

All Regional Facilities Constructed

Interim Facilities plus

Tyler Parkway Embankment
Eagle Crest Embankment – Main Channel Protection

Full Development Conditions

Local Detention Facilities – not included (PMP Design)

Note: Local Storage - Evaluated separately (2 to 100 year values)

Subjective Issues - Discussion

- All new development is Zoned R5 or R10 Residential
- Curve Numbers - change with development density (¼ to ¾ acre sites)
- Zoning Density > R10 will require on-site detention to limit discharges to existing conditions or cannot exceed R5
- Regional/Local Facilities to be defined (next step)

REGIONAL VS LOCAL SYSTEMS

Define a Regional Facility:
A storm water management facility designed to accommodate runoff generated by multiple subdivisions or development areas.

Draft Determination Guidance Criteria (any or all)

- Detention Storage > 25 acre-feet
  - Dam Safety Design Criteria – North Dakota State Engineer
  - Higher cost due to design requirements
- Drainage area > 50 acres
- Multiple subdivision or properties (number of lots)
- Storm Sewers > 36" in diameter
  - Cost must exceed $________ (per lot or total)
  - Procedural - Public Hearing on SID
  - Development area compared to total watershed
- City Engineer's Determination – Policy Decision

Define a Local Facility:
A storm water management facility designed to accommodate runoff generated from a single or several smaller subdivisions and/or single development type. (i.e., commercial, apartment complex, etc…).

Determination Guidance Criteria - If it is not regional it is local

Development Control Line

- DCL - To be defined and adopted
- Enforcement via Policy (Master Plan Adoption)
- Undevelopable Lands Policy
- Definition and enforcement options
    - Topography (~ 3:1 slopes and adjoining lands – 30 to 40% gradient)
    - Floodplain and Breach Zone
    - Approved subdivision plat boundaries
    - Aesthetics/Environmental
    - Wavier – (Balloon Theory) - City Engineering Discretion on offsets
- Development discharges into the DCL area
    - Storm Water Design Criteria
    - BMP's Required and Enforced
    - Zoning Definition (P – Public or new designation)

Issues with Draft DCL

- Development of the area from Golf Drive to Clairmont Road
    - **Note**: Most of this area does not fit into the DCL definition and remains developable. Is this a regional or local project area?
- Development of isolated slope areas not contiguous to other defined DCL boundaries. (i.e., West of Promontory Point along River Road)
- Areas designated for preservation – Ward Indian Village
- Pioneer Park and properties to the north along reconstructed channel
- Tyler Parkway and Burnt Boat Drive corridors and adjacent properties
- Valley Drive Corridor and adjacent properties
- Neighborhood Green Space (K&L Development) – Acquisition
- Need to refine prior to final acceptance

Next Step

Draft Final Alternative (Multiple Combinations – changes will occur)

Phased Development Issues

What elements must occur to cause regional project implementation?
Can these major features be delayed until necessary?

Local Storage Requirements – Review on a case-by-case basis

- Protection of DCL area
- **BMP Discussions - Alternative Methodologies (Discussion Topic)**

Next Meeting Date

Tyler Coulee – Master Plan Update
July 8, 2004

General Task Completion since June 2, 2004

- **Existing Conditions SWMM Hydrology Models Updated (2004)**
  - CN Values Refined for updated subwatershed and soils
  - Primary revisions due to "D" Soils in Watershed #2
  - Secondary revisions to incorporate approved developments

- **Existing and Future Regional Detention Facilities Defined**
  - Draft Technical Memorandum – Revised
    - Clairmont Road (no modifications)
    - Valley Drive Embankment (PMP - modifications)
    - Morgan Court Storm Water Facilities (under construction)
    - Tyler Parkway – (PMP - future facility)
    - Eagle Crest Embankment – (future facility < 25 acre-feet of storage)
    - Valley Drive East Embankment (PMP - modifications)
    - Overland Road Embankment (PMP - modifications)
  - State Engineer Jurisdictional Issues – Internal Review Completed
    - Dam Safety Criteria – Hazard Classification
    - 0.5 PMP Design (10.5 inch rainfall in 6 hours)
    - Preliminary Dam Breach/Floodplain Modeling (HEC-RAS, Partial)

- **Project Alternative Development – on-going and incomplete**
  - Local detention facilities identified
  - Alternative Modeling Considerations
    - Existing Conditions - 2005
    - Intermediate Conditions - 2015
    - Master Plan Conditions - 2025
  - Development Options Under Consideration
    - Structural – Detention etc…
    - Non-Structural – low density development
    - Erosion control elements
  - Regional Alternative Technical Memo – next step

- **Developable Land and Green Space Analysis – GIS**
  - Development Control Line (DCL) – preliminary mapping

Tyler Coulee Watershed - Reconnaissance Level Opinion of Probable Cost

Regional Project Alternative (RPA)		
Valley Drive Embankment		**$1,106,040**
Valley Drive East Embankment		**$96,690**
Tyler Parkway Embankment		**$828,160**
Overland Road Embankment		**$118,140**
Eagle Crest Embankment		**$430,485**
	Total RPA Cost	**$2,579,515**
	Cost Range	**$3.0 to $3.5 Million**

Tyler Coulee

General Watershed Development Summary

Total Drainage Area	**1,905**	**acres**	
Developed Area (platted)	**991**	**acres**	**52%**
Undeveloped Area	**914**	**acres**	**48%**
Area Distribution for Undeveloped Property			
Development Control Line Area	**348**	**acres**	**18%**
Green Space			
Future Park Land (trails etc...)			
Floodplain/Breach Zone			
Steep Slopes (3:1 @ 149 acres)			
Remaining Developable Properties	**566**	**acres**	**30%**

Current Platted Lots	**1,250**
Potential Future Lots @2.2/acre	**1,246**

Tyler Coulee Storm Water Master Plan Work Group
August 5, 2004
7-9 p.m.
Public Works Building
Meeting Summary

Attending:
Citizens:
Fay Connell, Kyle Forster, Al Frank, Rodney Hoff, Kevin Holm, Scott Hopfauf, Don Jensen, Fred Kraft, Kelly Moldenhauer, Larry Nieters, Scott Olson, Chard Orn, Art Rhode, Lon Romsaas, Dennis Sailer, Kevin Thomas, Kevin Willis

City of Bismarck:
Keith Demke, Director of Utility Operations and Lisa Ansley, Project Engineer

Houston Engineering:
Michael Gunsch

Keith Demke called the meeting to order at 7:00 p.m.

Keith Demke reminded everyone that the information from previous meetings is available on the City of Bismarck web page at www.bismarck.org.

Keith provided an update on the finance work group. The group was provided a copy of the handouts shared at the August 2, 2004 finance work group meeting (see web site for handouts). Keith summarized the handouts and explained that the proposal presented to the finance work group involved raising the storm water utility fee to allow the city to finance a portion of the future "regional" projects for the properties that are outside of city limits. As these properties are annexed into the city, an assessment would be applied to account for the costs that the city funded. It is estimated that the current storm water utility rate would need to be increased approximately $1.00/month to fund projects that are included in various master plans. This rate may need to be increased up to $2.00/month over the next several years.

Keith discussed the "local" improvements being paid by the developers and that there are several scenarios that are not straight forward and specific policies will need to be developed to make this a fair process.

Michael Gunsch provided a handout summarizing the master plan progress (see attached information).

Definitions of "local" and "regional" storm water facilities were the focus of the discussion. The elements of the definitions were provided in the handout along with examples of both types of facilities. The group discussed several issues with the definitions and scenarios when a project does not fit with the draft definitions.

The group recommended that the City develop master plans that layout the "regional" facilities. If a developer wants to build additional facilities that meet the "regional" definitions they will still need to be funded like a "local" improvement.

Michael presented a definition of the "development control line" (DCL). See attached information. The group expressed major concerns regarding the use of a DCL. The concerns ranged from the use of the DCL going beyond storm water management to the need to have a DCL that does not change. There was significant discussion by the group members regarding this issue. The following is a summary of some of the comments:

- If the DCL is on a map will property owners perceive this line as a line that cannot be changed?
- Will the developers be allowed to change the DCL?
- What level of approval will be required to change the DCL?
- The developer should not allowed to change the DCL without public input.
- If the DCL extends beyond what is needed to accommodate storm water would that be considered a taking?
- The definition of the DCL must be flexible. If the developer can show that the encroachment into the DCL will not impact upstream or downstream properties can it be allowed?
- We need to educate the public on storm water management.

Keith Demke suggested that the DCL may need to be two distinct lines. The first line would be the area needed to accommodate storm water. This line would be very difficult to justify any changes. The second line would be more flexible and would require the developer to pay for all costs associated with encroaching into this space.

The definition of the DCLs must be based on technical information not emotions and the enforcement of the lines will be very important to the management of this watershed.

Another challenge of developing a definition of the DCL is making this definition work city wide. Is it possible to have one definition work city wide or will this be watershed specific?

The group was asked to review the handout and provide comments to Lisa Ansley via e-mail at lansley@state.nd.us prior to the next meeting.

The next meeting was scheduled for September 16, 2004 at 7:00 p.m.

Tyler Coulee Storm Water Master Plan Work Group
September 16, 2004
7-9 p.m.
Public Works Building
Meeting Summary

Attending:
Citizens:
Fay Connell, Al Frank, Scott Hopfauf, Scott Olson, Chard Orn, Lon Romsaas, Kevin Thomas, Craig Bleth, Ed Murphy

City of Bismarck:
Keith Demke, Director of Utility Operations, Mel Bullinger, City Engineer and Lisa Ansley, Project Engineer

Houston Engineering:
Michael Gunsch

Keith Demke called the meeting to order at 7:00 p.m.

Keith Demke provided an update on the progress of the finance work group. The finance work group reviewed three alternatives for funding local storm water improvement projects, including special assessments, requiring the developer to be 100% responsible for design and construction of improvements or development of a storm water facility charge where developers would be required to pay a fee at the time of annexation to offset the costs of local drainage improvements. (See attached summary)

Michael Gunsch provided an update on the master planning process. The modeling has been completed and a briefing document has been prepared for submittal to the North Dakota State Water Commission to determine which storm water detention facilities will fall under that State Engineers jurisdiction.

Keith explained that after working on several complex definitions for defining local and regional drainage improvements it is the recommendation of city staff that the definitions be simplified. Definitions for both local and regional improvements were distributed to the group and are attached to the meeting summary.

It is the intent of the city that all regional facilities would be identified during watershed master planning. This would allow property owners to have access to planning for regional facilities.

The group discussed the Golf Drive storm water needs and how this area would fit into the proposed definitions for regional and local drainage improvements. The group discussed the option of removing this watershed from the overall Tyler Coulee watershed and identifying a separate watershed to address the needs of this area. Overall the group concurred that the properties that drain into Golf Drive do not contribute or benefit from any improvement upstream of Clairmont Road within the Tyler Coulee watershed.

The group discussed the need to develop a mechanism to incorporate runoff volume to the funding equation to either give credit to properties that are providing detention/retention or charging more to properties that have significant increases in runoff due to changes in land use. The group discussed utilizing either a runoff coefficient for each parcel or using the zoning classification to determine the additional charges.

The group discussed the development control line (DCL). A definition was developed and is attached to this meeting summary. The general idea is that all watershed master plans would include a DCL. Each DCL would be two tiered to identify undevelopable areas in the first tier and areas that development will be more tightly controlled within the second tier.

Several group members expressed concerns about creating a line on a map that would provide false security for property owners that the property identified in this DCL would never change. The City would need to find a method to educate the citizens on the intent of the DCL. There was also concern that other areas of construction code are being tied to storm water, such as slope stability, and that the creation of the DCL should not try to be all-inclusive and cover too many things.

It is the intent of the City that all future plats must identify the DCL and it will be the responsibility of city staff to recommend the approval or denial of any changes within the 2nd tier of the DCL. It is recommended that any changes to the 1st tier of the DCL would require approval by the City Commission.

The next meeting will be a combined meeting of the finance work group and the master plan work group. A future date will be selected and distributed to all group participants.

City of Bismarck Storm Water Financing
"Local" Improvement Project Financing

Options	*Pros*	*Cons*
Special Assessments *Description:* • Current process	• Process already in place •	• Multiple assessments for local improvements • City cannot assess properties outside of city limits •
Developer responsible for storm water improvements *Description:* • Developer would be responsible for the design and construction of all "local" drainage improvements necessary for the development of property	• Developers responsible for all costs associated with improvements • Upfront cost for homeowners •	• Multiple landowners in a drainage area could result in one developer holding the progress of other developers • Costs may not be equally spread to all contributing properties • Additional engineering and administration costs must be recovered
Storm Water Facilities Charge *Description:* • City would develop a storm water facilities charge for all newly developed properties • City would create more detailed storm water master plans to establish charge • The facilities charge would be paid by developers when the land is platted • City would manage the fund and design and construct improvements as needed to meet the growing needs of the community	• Upfront cost for homeowners • City responsible for more detailed watershed master planning • City would develop a funding mechanism for construction of "local" improvements as needed • Recovers costs associated with existing and planned infrastructure from newcomers to the system •	• Requires that a system be established and administered for setting, collecting and distributing facilities charges • Additional engineering and administration costs must be recovered

Local Storm Water Facilities

Local storm water facilities 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.

Regional Storm Water Facilities

Regional storm water facilities 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 of Bismarck through their watershed master planning process as main trunk line facilities. Master planned facilities will be defined in size and scope or simply designated to be 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/or green space.

Development Control Line

Two tiered approach to the control of development along drainage ways.

1st Tier – Very critical for the management of storm water conveyance. This area includes the floodway, floodplain, and maintenance access.

- This area can only be encroached upon by:
  - Collector or arterial roadways
  - Public utilities
  - Storm water detention and conveyance

2nd Tier – The intent of the 2nd tier is to identify areas of the watershed that are not in the best interest of the public to be developed. These areas will typically be identified as areas that have steep slopes and would require significant grading to make developable.

- Concerns with development in these areas:
  - Fills within the low lying areas typically results in a reduction of the conveyance capacity of the natural drainage ways. This reduction must be offset by the developer. The city must develop a method to account for this loss of conveyance and/or storage if encroachment into this area is to be considered.
  - The placement of excessive fills causing some concern for slope stability. *What mechanism could the city develop to assure adequate foundation stability? If fill is in excess of ___feet the building permit would require that a foundation be designed by a registered engineer.*
  - Steep slopes are generally difficult to establish vegetation. Erosion is a concern for both the stability of the slope as well as deposition of sediments in the downstream channels.

The city may allow a developer to encroach upon the 2nd tier if:

- The area of impact is considered minor and will not impact slope stability or storm water conveyance.
- The developer will mitigate the impacts on conveyance/storage of any fills placed within the drainage way. Mitigation can be either on site construction or finance contributions. The expense of any work within the DCL will not be paid for as a local or regional drainage improvement, but will be the sole responsibility of the developer.

The DCL should be a new requirement to be shown on all preliminary plats (in watersheds where the DCL has been established). Because we are dealing with mostly new plats that will be requesting waivers for the DCL the process is already in place to allow for public comments during the hearings before the planning and city commissions.

I would recommend that we consider presenting storm water master plans to the city commission. This would allow for the acceptance of the entire report. However, I do not think that we would want to require waiver requests to be presented to the city commission. This should be a responsibility of the City Engineer.

Joint Meeting
Tyler Coulee Watershed Master Plan Working Group
Storm Water Finance Issues Working Group
11/1/04
Meeting Summary

Attending:
Lisa Ansley, Craig Bleth, Mark Bohrer, Mel Bullinger, Fay Connell, Keith Demke, Mark Deutschman, Eugene Duchsherer, Brian Eiseman, R.L. Fischer, Kyle Forster, Al Frank, Lowell Fruhwirth, Michael Gunsch, Kevin Holm, Rodney Hoff, Scott Hopfauf, Don Jensen, Les Larson, Becky Jones Mahlum, Lon Romsaas, Dennis Schlenker, June Skuza, Connie Sprynczynatyk, Kevin Thomas, L. Anita Thomas, Charlie Whitman, Bill Wocken

Bismarck Public Works Utility Operations Director Keith Demke gave the two working groups background information on work each has completed.

Michael Gunsch, Houston Engineering, presented the work of the master plan work group. Michael presented the regional facilities that have been included in the master plan for the Tyler Coulee watershed and the Golf Drive watershed. The estimated costs of the regional improvements for Tyler Coulee are $2.5 to $2.7 million dollars plus additives. An estimate for the Golf Drive watershed regional improvements has not been completed but will be presented at the neighborhood meeting.

Keith Demke presented the development control line which the work group had decided would be strictly related to storm water improvements. *Tier one* of the control line would be land strictly reserved for maintaining and managing storm water. *Tier two* would be land where development is not desirable but is not prohibited. Additional review would be required by the city to allow development in the *tier two* areas and any additional storm water costs would have to be borne by the developer. Several issues with the control line were discussed, however, the overall consensus of the work group was that the DCL would provide the neighborhood assurance that development within the steep slopes and low lying areas would be reviewed by the City and the increased cost of developing these areas would not be the responsibility of other property owners within the watershed.

Keith explained that the finance group reviewed several alternatives for financing regional and local improvements. After much discussion, the consensus of the work group was that the regional improvements would be paid for using a revised special assessment process. This process would allow the City to construct regional projects as necessary and assess the properties within the city limits for their portion of the project costs. The portion of the project costs that are attributable to properties currently outside of the city limits would be financed by the City until such time as these properties are annexed. Upon annexation, these properties will be assessed the cost of previous improvements.

In order for the city to hold these costs in abeyance, until that property is annexed, a storm water revolving fund would need to be developed. A proposal to increase the existing storm water utility charge by $1 per month for everyone in the city was discussed.

Keith updated the group on the local finance issues and the alternatives that were discussed at the last finance work group meeting. Three options were discussed including, revised special assessment process, developer impact fee, and requiring the developer to be responsible for all design and construction of the local improvements. The group listened to the city's concerns regarding the option that required the developer to design and construct all local improvements. These concerns dealt mainly with the issue of multiple developers working together and the ability for one developer to stifle growth by not working with others. The group was concerned about impacts on development and from the very beginning has agreed that any recommendation must consider the impacts on development.

The group discussed the remaining two options for financing local improvements. Although several committee members originally favored the option of a developer impact fee, which would be based on an estimate of the required improvements for the local watershed, there was concern that this alternative could ultimately cost the property owners more in the long run. These potential increases could result from an overestimation in project costs, additional administration fees for the program, or the developer adding additional charges to lots to cover these fees.

Keith explained that there was the potential for a local finance plan that would utilize a combination of the revised special assessment process as well as a developer impact fee. The proposal would require that the developer pay 40 percent of the estimated costs for the local improvements up front (at the time of annexation) and all other costs would be assessed after construction. Again, the work group gave consideration to this option and suggested that it remain as a consideration, but did not see a benefit to the property owners in the long run. It was the consensus of the work group members that the recommendations from this committee needed to be the most equitable and ultimately the lowest cost solution. Because the revised special assessment process only requires that a property owner pay for the improvements after they are built and that everyone in the local watershed will pay an equal amount whether in or out of the city limits, it was the recommendation of the work group to offer the revised special assessment process as the preferred alternative for financing local improvements.

Connie suggested that the staff work on summarizing all of the work of the two work groups and prepare for a neighborhood meeting in early December.

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX C - 2

Finance Work Groups

Meeting Summaries

May 12, 2004
June 2, 2004
June 29, 2004
August 2, 2004
August 30, 2004
November 1, 2004

Storm Water Finance Issues Working Group
May 12, 2004
5-7 p.m.
Public Works Building
Meeting Summary

Attending:
Citizens:
Robert Fischer, Kent Hauge, Rodney Hoff, Lon Romsaas, Brian Eiseman, Anita Thomas; Scott Rising; Al Frank; Scott Wegner; Bob Entringer; Mark Bohrer; John Westbee; Kyle Foster; Donna Schauer; Robert Schauer

City of Bismarck:
Commissioner Connie Sprynczynatyk; Lisa Ansley, Project Engineer; Mel Bullinger, City Engineer; Dennis Schlenker, Finance Officer; Charlie Whitman, City Attorney; Becky Jones Mahlum, Public Information Officer; Bill Wocken, City Administrator

Commissioner Connie Sprynczynatyk called the meeting to order at 5:05 p.m.

Commissioner Sprynczynatyk and city staff reviewed the background on issues brought up by the public during the April 12, 2004 Tyler Coulee Watershed information meeting. Those issues included:

- Multiple assessments: Lisa Ansley explained how the city creates a special assessment district and how the city determines when improvements should be constructed. Ansley said the city doesn’t do projects in advance of development because the city can not accurately predict how, where and when property will be developed. Dennis Schlenker said homeowners are given credit for assessments they have previously paid when a new project is assessed (equalization process). Participants wanted to know if improvements are paid for by the developer in advance (and consequently reflected in the price a homeowner pays the developer for a lot); could they be given credit for that toward future assessments? Charlie Whitman suggested the group could look into setting up “ghost” assessment districts to give credit for pre-paid improvements.
- Contributing/benefiting properties: Bill Wocken explained what the city considers to be a contributing property in a storm water improvement project.
- Developers sharing in the costs of storm water projects.

Lisa Ansley talked about what other cities were doing to fund storm water projects. She said Sioux Falls has developed a detailed master plan for storm water and has developer impact fees to pay for improvements. For larger improvements, the developer pays half the costs and the city picks up the other half. The city’s portion is funded through utility fees. Ansley said some communities fund all projects through a city-wide fee, others assess developers a flat fee for new properties based on zoning. Some assess fees based on costs in a particular watershed.

The group reviewed several options:

- Impact fees to be paid by developers that would go toward future storm water projects.
- Developers pay for improvements up front. The question was raised how the city could equalize the costs between developments with some requiring larger pipes than others. Ansley said if there was a storm water master plan, those costs could be equalized.
- Ask Burleigh County Water Resource District (BCWRD) to participate financially in projects. The group requested that a representative from the resource district be asked to attend the next meeting.
- Create a joint powers agreement with the BCWRD.
- Create a joint powers agreement with Burleigh County.
- Request a change in state law allowing cities to tax land in the county for storm water improvements. Bill Wocken told the group that a previous attempt to introduce such legislation was soundly defeated in committee.
- Require a storm water master plan before development begins in any watershed. The group agreed this was a good idea. The group requested a presentation at the next meeting on the progress of the current Tyler Coulee Watershed master plan study for the Tyler Coulee Watershed.
- Raise monthly storm water fees citywide to subsidize improvement projects. The group asked that a summary be provided at the next meeting explaining the current storm water utility charge and what that money goes toward.

At its next meeting, the group will review these options in detail and discuss suggested guidelines for solutions:

- Not putting anyone out of business
- Establishing a finance system that works across the City of Bismarck
- Equalize assessments

The next meeting date was set for June 2nd at 5:15 p.m. at the Public Works Building.

Storm Water Finance Working Group
Meeting Summary
June 2, 2004
Public Works Conference Room

Community participants present:
Al Frank, Scott Rising, Donna Schauer, Scott Wegner, Bob Entringer, Lon Romsaas, Kent Hauge, Mark Bohrer, John Westbee, Rodney Hoff, Anita Thomas, Steve Smokey, Gene Duchsherer, Kyle Forster, Fay Connell, Paul Maddock

City staff present:
City Administrator Bill Wocken, City Finance Officer Dennis Schlenker, City Attorney Charlie Whitman, Project Engineer Lisa Ansley, Public Information Officer Becky Jones Mahlum; Public Works Utility Operations Director Keith Demke, City Commissioner Connie Sprynczynatyk

Burleigh County Water Resource District representatives present:
Harvey Melstad, Dave Bliss, Mike Gunsch

City Commissioner Connie Sprynczynatyk called the meeting to order at 5:15 p.m. Commissioner Sprynczynatyk provided a summary of the previous Finance Working Group's last meeting held on May 12, including the options the group considered and the information gathered on what other communities are doing to fund storm water projects. One participant expressed interested in Sioux Falls's funding procedure. Sioux Falls currently requires that the developer pay 100- percent of the local storm sewer improvements within a subdivision (up to 24" storm sewer pipe). Regional storm sewer (larger than 24") is shared equally between the city and the developer. City Attorney Whitman expressed his concern about the use of impact fees. Whitman said the fees would be very labor intensive to set-up and would not provide a mechanism to fund further improvements.

City Finance Officer Schlenker explained how special assessments are equalized to evenly share costs in projects. Schlenker said if a homeowner pays for one local storm water improvement project, that amount is taken into account if further local storm water improvement projects are assessed to the same property.

Houston Engineering's Michael Gunsch gave an update on the Tyler Coulee Watershed Master Plan Study. Gunsch described the elements that will go into a master plan including:

- Update hydrology models to show existing conditions in the watershed,
- Define existing and future regional detention facilities,
- Develop project alternatives, and
- Analyze green space alternatives and other non-structural options.

Gunsch said he anticipates that the Master Plan Working Group will have developed alternatives by next month and that Houston Engineering will have the Master Plan completed by this fall. The group asked that they have an update on Master Plan Study progress at the beginning of the next meeting. They group was informed that a digital copy of the 2002 Tyler Coulee Water Quality Assessment and Management Plan will be placed on the City of Bismarck web site at www.bismarck.org. Commissioner Sprynczynatyk pointed out that this study focused primarily on water quality issues and was not a complete master plan.

Concern was expressed about the City Commission's approval, at its last meeting, of a local storm water project without the completion of the master plan. Participants wanted assurance that this project would be included in the master plan. The group talked about what defines "local" and "regional" projects. Local projects were defined as storm water improvements for water draining from a specific sub-watershed (neighborhood). Regional projects would be larger storm water improvements with water draining from many areas of the watershed.

Participants were concerned about the safety of detention ponds that may be part of the master plan. Gunsch said the detention facilities could be designed in a way that they would stay dry. These are the types of issues that the Tyler Coulee Storm Water Master Plan Working Group will be addressing. A community member shared that some Minnesota communities have ordinances requiring a certain amount of green space and said he wants the city to grow properly. Another participant shared that some cities within the state of Washington are requiring all new developments to have their own water retention facilities.

Gunsch made a presentation on the working group's question about whether the Burleigh County Water Resource District (BCWRD) could participate in Bismarck storm water improvement projects. BCWRD Chairman Harvey Melstad said the resource district could not finance storm water improvements itself but could assist in the collection of funds in Burleigh County to pay for the improvements. Melstad also said county land would be assessed at a lower, agricultural rate if the land was not developed. Group participants said BCWRD participating could be part of a mix of solutions to the city's finance issue.

At the request of the group, Public Works Utility Operations Director Keith Demke talked about storm water utility fees. Demke said the fees go into an enterprise fund that is used to fund storm water maintenance projects and the Phase 2 Storm Water program related to water quality. The fund also pays for planning such as the master planning being done on watersheds across the city. He said the fund currently generates about $625,000/year. Demke said the program budget is $500,000/year but because it is not fully staffed and the program is not fully implemented they have only been spending about $200,000/year. The current fund balance is $2.1 million. He said single-family homeowners pay $1.75/month in storm water fees and $3.50/10,000 square feet is the fee for commercial and industrial properties. Demke said this enterprise fund could serve as the “banker” for growth-related storm water projects but the current fee structure would not cover the costs.

Commissioner Sprynczynatyk explained that there does not appear to be one answer to this issue, and the group will need to look at how various options might work together to address the storm water financing issue for the entire city.

The group said it would like to see an analysis of financing options at the next meeting. There was also interest in getting “ball-park” estimates of what storm water improvement projects would cost for the entire watershed but concern was voiced that this figure would be difficult to generate until the master plan is finished.

The next meeting date was set for June 29, 2004 at 5:15 p.m.

Storm Water Finance Working Group

6/29/04

Meeting Summary

Citizen Members Attending:
Al Frank, Lon Romsaas, Mark Bohrer, Rodney Hoff, Steve Smokey, Gene Duchsherer, Fay Connell, Fred Kraft, Robert Fischer, George Keiser,

Attending from City of Bismarck:
Lisa Ansley, City Engineering; Bill Wocken; City Administration; Dennis Schlenker, City Administration; Connie Sprynczynatyk, City Commission; Becky Jones Mahlum, City Administration, Keith Demke, Public Works Utility Operations; Charlie Whitman, City Attorney; Mel Bullinger, City Engineer

Also attending:
Michael Gunsch, Houston Engineering; Angie Buckley, Bismarck Tribune

Commissioner Connie Sprynczynatyk called the meeting to order at 5:15 p.m.

The working group reviewed what happened at the last meeting.

Michael Gunsch, Houston Engineering, provided an update on the Tyler Coulee Watershed Master Plan. The master plan working group meets July 8 and is working on a model for the master plan. Gunsch said preliminary estimates are that costs could be $3 million to $3.5 million for regional storm water projects in the watershed. Gunsch said that figure does not include local projects. He said the master plan working group is looking at creating a development control line. Gunsch showed a videotaped aerial tour of the coulee and pointed out where potential regional and local facilities could be built.

The group reviewed a funding alternatives matrix prepared by city staff which includes the options of using assistance from the Water Resource District, storm water utility fees, special assessments, development impact fees, sales taxes, and grants. Sprynczynatyk said the group should look for a layered approach to funding storm water improvements that will use more than one of these options.

Members of the working group emphasized that they want to find a funding mechanism that will include land outside the city limits. They suggested establishing a storm water utilities fund. That fund could carry a portion of the cost of projects which benefit land that is currently outside the city limits but contributes to the need for storm water improvements. That land would then be assessed for its share of the improvements when it is developed. Providing a way for outside property to eventually share in the cost would bring down the price tag for those inside city limits.

The working group looked at ways to put money in this utility fund. City Attorney Charlie Whitman pointed out that city sales tax funds can be spent on storm water utility projects, but sales taxes are committed for the next four to five years. Sprynczynatyk said the group will have to look at multiple payment sources for the fund and reminded the group that the fund would also need to pay for storm water projects across the city. She asked that city staff determine how much money would need to be accumulated in such a fund.

Sprynczynatyk gauged from the group that sharing costs with land outside the city limits was the group's top priority. The group talked about what the second and third most important solutions would be. Some talked about factoring into the equalization process storm water improvements developers do themselves so homeowners can get credit for that work. It was noted that some cities do not access for local projects, the developers take care of that work.

The working group talked about the problems created by using a utility fund to build projects in a watershed before development happens. Keith Demke said it may turn out that some of the projects would not need to have been built if development doesn't materialize. Charlie Whitman said early projects may waste some of the useful life of the projects if they're built too far ahead of the need. Sprynczynatyk added that the facilities would need to be maintained.

Sprynczynatyk asked that staff gather more information on a layered solution that will bring down the cost to the people living in the area. She suggested the group develop a solution for Tyler Coulee and see if it works for other watersheds.

The group's next meeting will be August 2 2004, 5:15 p.m., Public Works Conference Room.

Storm Water Finance Working Group
Meeting Summary

August 2, 2004
5:15 p.m.

Attending:
Becky Jones Mahlum, Kyle Foster, Lisa Ansley, Rodney Hoff, Lon Romsaas, Bill Wocken, Connie Sprynczynatyk, Charlie Whitman, Al Frank, Fay Connell, Keith Demke, Don Jensen, Robert Fischer, Michael Gunsch, June Skuza

Commissioner Connie Sprynczynatyk reviewed what the working group did at its last meeting.

Michael Gunsch highlighted the progress of the Tyler Coulee Watershed Storm Water Master Plan Working Group. Gunsch said the group is looking at establishing a better definition of local and regional storm water projects. He said they are also studying creating development control lines.

The finance working group is examining how to spread the costs of regional storm water improvements when some of the land contributing to the need for the improvements is not yet in the city limits. Keith Demke showed the group a document outlining what the city would have to do to finance the unannexed portion of a project until that land was annexed and could be assessed. Demke said the Tyler Coulee Watershed includes about 991 acres of property within the city limits and a projected 566 acres of developable land outside the city limits. He said that means approximately 36.4% of the improvement costs would need to be held by the city for future assessment.

Demke said preliminary figures show if costs were spread to all contributing parties, in and outside the city limits, proposed projects for the Tyler Coulee Watershed would cost land owners approximately 4.4 cents/square foot. Additional costs for financing and engineering fees would bring the cost up to around 5.5 to 6 cents/square foot. If the costs were shared only by those inside the city limits, the cost would be 7 cents/square foot, plus additional costs.

Demke said a 98 cent/10,000 square ft. of lot space/month increase to the city Storm Water Fee should bring in enough money to build up a fund that would finance the unannexed portion. The group discussed whether the money could come through an increase in water fees instead, but City Attorney Charlie Whitman said the city traditionally will not pay for improvements for one system with fees from another.

The working group discussed whether the city could require developers to pay for local storm water improvements. One of the problems discussed was what happens when there is more than one owner in an area that needs a local project, and one of the owners is not ready to develop. Could the city temporarily finance a portion of the improvement costs until the rest of the land can be assessed?

Commissioner Sprynczynatyk asked city staff to develop options for financing local storm water improvements including impact fees, developers doing the work themselves or a combination of financing mechanisms.

The next meeting was set for August 30 at 5:15 p.m.

Storm Water Finance Working Group
08/30/04
Meeting Summary

Citizen Members Attending:
Al Frank, Lon Romsaas, Mark Bohrer, Rodney Hoff, Gene Duchsherer, Fay Connell, Bob Entringer, June Skuza, Scott Wegner

Attending from City of Bismarck:
Connie Sprynczynatyk, City Commission; Bill Wocken; City Administration; Dennis Schlenker, City Administration; Keith Demke, Public Works Utility Operations; Charlie Whitman, City Attorney; Mel Bullinger, City Engineer; Lisa Ansley, City Engineering.

Commissioner Connie Sprynczynatyk called the meeting to order at 5:15 p.m.

Lisa Ansley provided a brief update on the master plan work group. The group is focusing on two issues. The first issue is the development of a definition of regional versus local drainage improvements. The second is the formulation of a development control line (DCL). The group is considering a two tiered DCL that will have a definite no build line as well as another line that will require additional consideration prior to approval of development within this area. The group will meet again on September 16, 2004 to finalize the definitions.

The group reviewed a funding alternatives matrix prepared by city staff for the funding of **local** drainage improvements. Three alternatives were reviewed, including using the current special assessment process, requiring 100% of the cost of local improvements be paid up front by the developer, and developing a storm water development facility charge that would be charged to all new development.

The group discussed the alternative that has the developer being responsible for 100% of the local improvements. Several problems were brought up with this option, including not all lands within the local watershed boundary will be owned by one owner, the requirement that the burden of this level of planning and funding being placed on the developer could stifle development, and it would be difficult for a developer to determine the equitable split of these projects and to get funds from properties that are not currently developing.

The next alternative discussed involved the creation of a storm water development facility charge. The city would develop a fee for each watershed that would be paid by the developer at the time of annexation. The fee would be based on master planned needs for the watershed and would strictly be an educated guess at the final project costs. Several issues were discussed regarding this alternative, including the need for a higher level of detail for storm water master planning, a financial consultant would need to be hired by the city to develop the funding formulas, a process would need to be developed to correct for project costs that were not estimated within a specified tolerance and the consensus of the group was that this alternative could ultimately cost the property owners more in the long run.

A question was posed to the group regarding the current special assessment process. If the city would be willing to cover the assessments for portions of property outside of the city limits until such time as these properties are annexed, would the use of special assessments be acceptable for local drainage improvements? There was still some concerns with the need to multiple assess properties. Several questions were brought up that need to considered for future discussion –

- Can the city estimate what the needs are for a local drainage area and find a way to make this information more ready available to property owners?
- Can the city devise an educational tool to help explain the process of equalization of special assessments for property owners?
- Can the city inform property owners that there will be multiple assessments for drainage improvements?

Connie Sprynczynatyk asked that the group participate in one more meeting before taking the recommendations back to the neighborhood. The next meeting with be a group meeting with the master plan work group and will attempt to summarize the progress of both work groups and recommendations that will be presented to the neighborhood group as well as the city commission.

The next meeting will be scheduled for early to mid October and notices will be sent out with the date and time.

City of Bismarck Storm Water Financing
"Local" Improvement Project Financing

Options	*Pros*	*Cons*
Special Assessments *Description:* • Current process	• Process already in place •	• Multiple assessments for local improvements • City cannot assess properties outside of city limits •
Developer responsible for storm water improvements *Description:* • Developer would be responsible for the design and construction of all "local" drainage improvements necessary for the development of property	• Developers responsible for all costs associated with improvements • Upfront cost for homeowners •	• Multiple landowners in a drainage area could result in one developer hampering the progress of other developers • Costs may not be equally spread to all contributing properties • Additional engineering and administration costs must be recovered
Storm Water Facilities Charge *Description:* • City would develop a storm water facilities charge for all newly developed properties • City would create more detailed storm water master plans to establish charge • The facilities charge would be paid by developers when the land is platted • City would manage the fund and design and construct improvements as needed to meet the growing needs of the community	• Upfront cost for homeowners • City responsible for more detailed watershed master planning • City would develop a funding mechanism for construction of "local" improvements as needed • Recovers costs associated with existing and planned infrastructure from newcomers to the system •	• Requires that a system be established and administered for setting, collecting and distributing facilities charges • Additional engineering and administration costs must be recovered •

Joint Meeting
Tyler Coulee Watershed Master Plan Working Group
Storm Water Finance Issues Working Group
11/1/04
Meeting Summary

Attending:
Lisa Ansley, Craig Bleth, Mark Bohrer, Mel Bullinger, Fay Connell, Keith Demke, Mark Deutschman, Eugene Duchsherer, Brian Eiseman, R.L. Fischer, Kyle Forster, Al Frank, Lowell Fruhwirth, Michael Gunsch, Kevin Holm, Rodney Hoff, Scott Hopfauf, Don Jensen, Les Larson, Becky Jones Mahlum, Lon Romsaas, Dennis Schlenker, June Skuza, Connie Sprynczynatyk, Kevin Thomas, L. Anita Thomas, Charlie Whitman, Bill Wocken

Bismarck Public Works Utility Operations Director Keith Demke gave the two working groups background information on work each has completed.

Michael Gunsch, Houston Engineering, presented the work of the master plan work group. Michael presented the regional facilities that have been included in the master plan for the Tyler Coulee watershed and the Golf Drive watershed. The estimated costs of the regional improvements for Tyler Coulee are \$2.5 to \$2.7 million dollars plus additives. An estimate for the Golf Drive watershed regional improvements has not been completed but will be presented at the neighborhood meeting.

Keith Demke presented the development control line which the work group had decided would be strictly related to storm water improvements. *Tier one* of the control line would be land strictly reserved for maintaining and managing storm water. *Tier two* would be land where development is not desirable but is not prohibited. Additional review would be required by the city to allow development in the *tier two* areas and any additional storm water costs would have to be borne by the developer. Several issues with the control line were discussed, however, the overall consensus of the work group was that the DCL would provide the neighborhood assurance that development within the steep slopes and low lying areas would be reviewed by the City and the increased cost of developing these areas would not be the responsibility of other property owners within the watershed.

Keith explained that the finance group reviewed several alternatives for financing regional and local improvements. After much discussion, the consensus of the work group was that the regional improvements would be paid for using a revised special assessment process. This process would allow the City to construct regional projects as necessary and assess the properties within the city limits for their portion of the project costs. The portion of the project costs that are attributable to properties currently outside of the city limits would be financed by the City until such time as these properties are annexed. Upon annexation, these properties will be assessed the cost of previous improvements.

In order for the city to hold these costs in abeyance, until that property is annexed, a storm water revolving fund would need to be developed. A proposal to increase the existing storm water utility charge by $1 per month for everyone in the city was discussed.

Keith updated the group on the local finance issues and the alternatives that were discussed at the last finance work group meeting. Three options were discussed including, revised special assessment process, developer impact fee, and requiring the developer to be responsible for all design and construction of the local improvements. The group listened to the city's concerns regarding the option that required the developer to design and construct all local improvements. These concerns dealt mainly with the issue of multiple developers working together and the ability for one developer to stifle growth by not working with others. The group was concerned about impacts on development and from the very beginning has agreed that any recommendation must consider the impacts on development.

The group discussed the remaining two options for financing local improvements. Although several committee members originally favored the option of a developer impact fee, which would be based on an estimate of the required improvements for the local watershed, there was concern that this alternative could ultimately cost the property owners more in the long run. These potential increases could result from an overestimation in project costs, additional administration fees for the program, or the developer adding additional charges to lots to cover these fees.

Keith explained that there was the potential for a local finance plan that would utilize a combination of the revised special assessment process as well as a developer impact fee. The proposal would require that the developer pay 40 percent of the estimated costs for the local improvements up front (at the time of annexation) and all other costs would be assessed after construction. Again, the work group gave consideration to this option and suggested that it remain as a consideration, but did not see a benefit to the property owners in the long run. It was the consensus of the work group members that the recommendations from this committee needed to be the most equitable and ultimately the lowest cost solution. Because the revised special assessment process only requires that a property owner pay for the improvements after they are built and that everyone in the local watershed will pay an equal amount whether in or out of the city limits, it was the recommendation of the work group to offer the revised special assessment process as the preferred alternative for financing local improvements.

Connie suggested that the staff work on summarizing all of the work of the two work groups and prepare for a neighborhood meeting in early December.

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX D

Valley Drive Embankment,
Tyler Parkway Embankment
and
Morgan Court Storm Water Facilities
Preliminary Hydraulic Design

APPENDIX D
VALLEY DRIVE EMBANKMENT,
TYLER PARKWAY EMBANKMENT
AND MORGAN COURT STORM WATER FACILITIES
PRELIMINARY HYDRAULIC DESIGN

INTRODUCTION

In accordance with the scope of engineering services for the Tyler Coulee Master Plan Update, this document summarizes a preliminary hydraulic design analysis for the existing Valley Drive Embankment and the future Tyler Parkway Embankment located on Tyler Coulee. In addition, a preliminary design configuration for the Morgan Court North and Morgan Court South Storm Water Facilities is also presented. The Morgan Court facilities were constructed by the developer under the City of Bismarck's (City) direction following the completion of a draft of this technical memorandum and in accordance with the general recommendations contained herein.

Prior to preparing this update, a comprehensive storm water master plan for the Tyler Coulee Watershed was completed in June 2002 by Houston Engineering (2002 Report). This master plan defined several potential storm water detention areas along Tyler Coulee and projected the results from the 2-year to the 100-year synthetic rainfall events. This analysis, however, did not address the design criteria associated with an embankment classified by the North Dakota State Engineer (NDSE) as high hazard. This master plan update includes an evaluation of the Valley Drive Embankment and other storm water detention facilities and a dam breach analysis in accordance with the NDSE's design criteria. This updated master plan also establishes a Development Control Line (DCL) based on the inundation area associated with a dam breach or local 100-year floodplains.

Four SWMM hydrologic models were completed to evaluate hydraulic design conditions at Valley Drive. The first model updated the 'existing' conditions model from the original storm water master plan to include current development without any of the proposed changes to the Valley Drive Embankment and without construction of the Morgan Court or Tyler Parkway detention facilities. The second model used the updated existing conditions model updated further with the addition of the Morgan Court storm water facilities to evaluate modifications to the Valley Drive Embankment. The third model evaluated the impacts on the modified Valley Drive Embankment assuming construction of the Tyler Parkway Embankment and an intermediate level of development within the watershed. The fourth model assumes a fully developed watershed. **Table 1** lists the assumptions used for each of the four models. **Table 2** lists the six-hour cumulative rainfall amounts utilized for this evaluation.

TABLE 1 SWMM Hydrologic Models				
Model	**Development**	**Valley Drive Embankment**	**Morgan Court Detention**	**Tyler Parkway Embankment**
Model #1	Updated Existing	Existing	No	No
Model #2	Updated Existing	Modified	Yes	No
Model #3	Intermediate	Modified*	Yes	Yes
Model #4	Ultimate	Modified*	Yes	Yes
*Emergency Spillway Reduced in Size Because of Tyler Parkway Detention Storage				

TABLE 2 Six-Hour Cumulative Rainfall Depth	
Frequency	**Cumulative Depth (inches)**
2–yr	1.6
5-yr	2.2
10–yr	2.5
25-yr	3.0
50–yr	3.4
100–yr	3.8
0.5 PMP	10.5

VALLEY DRIVE EMBANKMENT

The existing Valley Drive Embankment on Tyler Coulee consists of an earthen embankment with a 48” RCP, by 200 foot long principal spillway. The upstream invert of the 48” RCP culvert is at approximately elevation 1682.3, while the top of the embankment is approximately elevation 1708.5 and there is no emergency spillway. **Table 3** lists the projected discharges, water surface elevations and storage under existing watershed conditions.

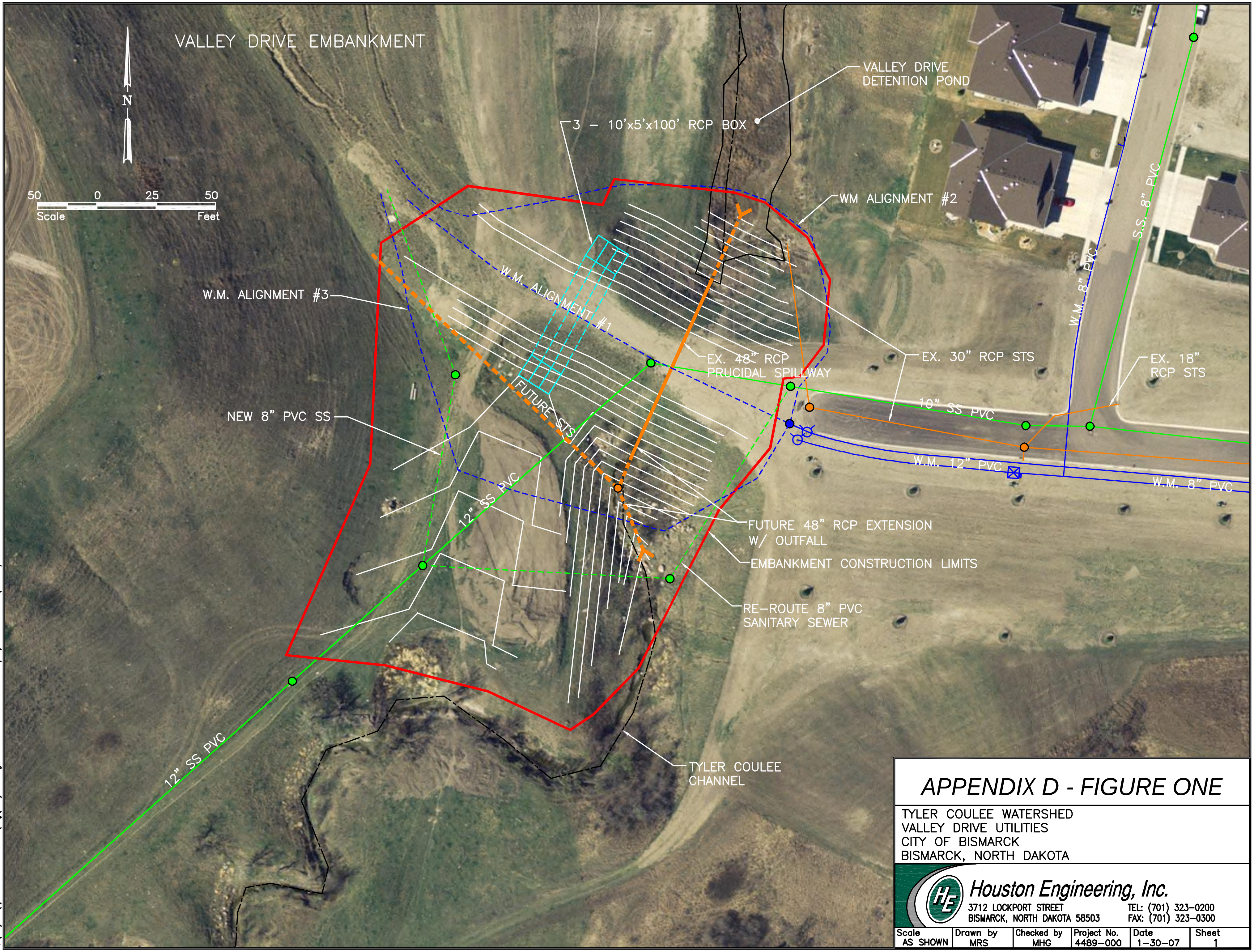
The Valley Drive Embankment is an integral component of the 2002 Tyler Coulee Watershed Master Plan. The detention storage provided behind this embankment provides a considerable reduction in peak flows downstream when compared to inflows. The 2002 Master Plan also proposed a reduction in the size of the outlet control culvert from the current 48” RCP to a 24” RCP, to facilitate further reductions in discharges on the more frequent flood events.

TABLE 3 **Valley Drive Embankment** **Existing Conditions (Model #1)**				
Frequency	**Peak Discharge 48" RCP (cfs)**	**Peak Discharge Overtopping (cfs)**	**Maximum Water Surface Elevation (msl/NAVD-29)**	**Maximum Storage (acre-feet)**
2-yr	107	0	1688.6	2.6
5-yr	167	0	1693.4	13.7
10-yr	186	0	1695.4	22.6
25-yr	213	0	1698.6	41.0
50-yr	232	0	1701.0	59.7
100-yr	248	0	1703.3(1)	80.0
0.5 PMP	295	2704	1710.8(2)	161.4
Note: 1) 5.2 feet of freeboard is provided on a 100-year event. **2) Does not meet 0.5 PMP design criteria with 48" RCP; top of the embankment is 1708.5 msl/NAVD-29**				

Due to its location and the potential loss of life upon failure, the Valley Drive Embankment is classified as a high hazard facility by the NDSE. In order to comply with the NDSE's dam safety requirements, the Valley Drive embankment must pass a 0.5 Probable Maximum Precipitation (PMP) rainfall event without overtopping. As shown in **Table 2** the rainfall depth on a 0.5 PMP event is more than 2.75 times that of a 100-year 6-hour rainfall event. To facilitate this significant increase in projected runoff, an emergency spillway consisting of box culverts discharging to an open channel emergency spillway was incorporated into the proposed embankment design to prevent overtopping. Subsequently, three scenarios were evaluated to size the box culverts under Valley Drive. All proposed modifications to the Valley Drive Embankment include the utilization of a weir wall and drop inlet to maximize or maintain the 100-year event detention capability and to provide adequate cover for future street construction.

Model #2, which included an updated level of development within the watershed as of 2005 as well as construction of the Morgan Court storm water facilities, was the first model used to evaluate modifications to the Valley Drive Embankment. The following is a summary of the proposed design elements for the Valley Drive Embankment under this scenario, see **Figure One**:

- Existing 48" RCP extended upstream and downstream (~ 50 feet);
- (3) 10' x 8' RCP box culverts with invert elevations at 1699.0;
- Upstream Weir Wall at the opening of box culverts at elevation 1704.0;
- Minimum top of embankment set at elevation 1710.0; and
- Open Channel Earthen Spillway at 3.7% and 60-foot bottom width.



APPENDIX D - FIGURE ONE

TYLER COULEE WATERSHED
VALLEY DRIVE UTILITIES
CITY OF BISMARCK
BISMARCK, NORTH DAKOTA

Houston Engineering, Inc.
3712 LOCKPORT STREET
BISMARCK, NORTH DAKOTA 58503
TEL: (701) 323-0200
FAX: (701) 323-0300

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	MRS	MHG	4489-000	1-30-07	1

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Several alternative alignments for the emergency spillway section were evaluated, including eastern, central and western locations. The western alignment was chosen due to the relatively shallow slope, 3.7 percent versus the 23.3 percent or more encountered on the central and eastern alignments. The central and eastern alignments did not comply with the NDSE's design criteria. The western alignment provides the ability to increase the bottom width of the spillway channel to match the opening of the box culverts and further reduce maximum velocities. It is also a more viable location due to its placement largely within native soils. The proposed design for the spillway covering as it relates to the NDSE's velocity considerations was not determined. Preliminary findings indicate velocities exceed 12 fps on a 0.5PMP event for a period of less than two (2) hours. The specific use of turf reinforcement versus gabions or other erosion protection measures was not evaluated.

Table 4 lists the peak discharges, maximum water surface elevations, maximum storage, and changes in peak outflows compared to existing conditions. As shown in **Table 4**, there is relatively little change in peak discharges at the Valley Drive Embankment up to the 100-year event but there is a significant decrease of 1899 cfs on the 0.5 PMP event; using a higher embankment and new spillway section.

TABLE 4
Valley Drive Embankment - Model #2

Frequency	Peak Discharge 48" RCP (cfs)	Peak Discharge (3) 10' x 8' RCP's (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	104	0	1688.5	2.5	-3
5-yr	163	0	1693.0	12.2	-4
10-yr	182	0	1695.0	20.7	-4
25-yr	209	0	1698.1	37.8	-4
50-yr	227	0	1700.4	55.5	-5
100-yr	243	0	1702.6	73.0	-5
0.5 PMP	285	815	1709.2	150.5	-1899

Note: Model #2 assumes existing development including the Morgan Court facilities and the Pinehurst Square development. The model was used to size improvements to the Valley Drive Embankment. Freeboard on Valley Drive on a 100-year, 6-hour event is 7.4 feet using elevation 1710.0.

Model #3 assumes an interim level of development within the watershed with additional upstream detention storage provided at both the Morgan Court facilities and at Tyler Parkway. The following is a summary of the proposed design elements for the Valley Drive Embankment under these conditions:

- Existing 48' RCP extended both upstream and downstream (~50 feet);
- (3) 10' x 5' RCP box culverts with inverts at elevation 1699.0 (~100 feet);
- Upstream Weir Wall at the opening of box culverts at elevation 1704.0;
- Minimum top of embankment elevation set at 1710.0; and
- Open Channel Earthen Spillway at 3.7% and 60-foot bottom width.

The box culverts in the Valley Drive Embankment have been downsized due to the additional detention provided at Tyler Parkway. The impact of an intermediate level of development and full development on the Valley Drive facility without construction of the Tyler Parkway Embankment was evaluated, and the analyses confirmed that the capacity required to pass the 0.5PMP event at Valley Drive was so large that the most cost effective alternative was to construct the Tyler Coulee Embankment before those levels of development occur within the watershed, thus significantly reducing the size of the spillway works required at Valley Drive to the three 10’ x 5’ box culverts.

Table 5 lists the peak discharges, maximum water surface elevations, maximum storage, and changes in peak discharges when compared to existing conditions. As shown in **Table 5,** there is a measurable decrease in peak discharges from the Valley Drive Embankment. The largest decrease, 666 cfs, occurs on the 0.5PMP rainfall event, illustrating the value of these storage components.

TABLE 5
Valley Drive Embankment - Model #3

Frequency	Peak Discharge 48” RCP (cfs)	Peak Discharge (3) 10’ x 5’ RCP’s (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	115	0	1689.2	3.5	+8
5-yr	166	0	1693.3	13.1	-1
10-yr	182	0	1694.9	20.6	-4
25-yr	201	0	1697.1	31.5	-12
50-yr	214	0	1698.7	42.4	-18
100-yr	226	0	1700.3	53.8	-22
0.5 PMP	273	1470	1707.2	123.9	-666

Note: Model #3 includes improvements to Valley Drive, Tyler Parkway, and Morgan Court. Freeboard on the 100-year event is 9.7 feet, while, on the 0.5 PMP event, 2.8 feet of freeboard is provided.

Model #4 includes the proposed future embankment at Tyler Parkway and the Morgan Court facilities and assumes a fully developed watershed. The following is a summary of the proposed design elements for the Valley Drive Embankment required under these conditions:

- Inlet to existing 48” RCP restricted to 36” for low flow control;
- Principal Spillway Inlet Riser 72” RCP with weir elevation at 1702 msl;
- (3) 10’ x 5’ box culverts with inverts at elevation 1701.0;
- Upstream Weir Wall at the opening of box culverts at elevation 1704.0;
- Minimum top of embankment elevation set at 1710.0; and
- Open Channel Spillway at 3.7 percent slope and 60-foot bottom width.

Table 6 lists the peak discharges, maximum water surface elevations, maximum storage, and changes in peak outflows compared to existing conditions. As shown in **Table 6**, with the additional storage and controls implemented upstream at the Tyler Parkway Embankment, decreases in peak discharges are projected on all rainfall events, even with the watershed fully developed, with the greatest decrease of 1239 cfs occurring on the 0.5PMP rainfall event.

TABLE 6
Valley Drive Embankment - Model #4

Frequency	Peak Discharge 48" RCP (cfs)	Peak Discharge (3) 10' x 5' RCP's (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	95	0	1692.9	11.9	-12
5-yr	118	0	1697.4	36.3	-49
10-yr	126	0	1699.2	46.1	-60
25-yr	136	0	1701.7	65.7	-77
50-yr	187	0	1703.0	77.6	-45
100-yr	243	0	1703.6	83.4	-5
0.5 PMP	336	1424	1707.9	132.2	-1239

Note: Model #4 includes proposed improvements to Valley Drive, Morgan Court and a proposed Tyler Parkway Embankment with a fully developed watershed.

Under this scenario the emergency spillway box culverts remain reduced in size and additional control is added by reducing the primary spillway inlet from a 48" RCP to a 36" RCP. More importantly, from a design and flood control perspective, the projected emergency spillway flows on a 0.5 PMP event are reduced by more than 47 percent from the overtopping flows that would occur without the proposed improvements to Valley Drive under current development. Based on this analysis, the Valley Drive Embankment could be re-constructed with three 10' x 8' box culverts to handle existing conditions, and those box culverts would be more than adequate once the watershed is fully developed and the Tyler Parkway Embankment is constructed.

Based on this analysis it appears there are significant cost savings and value associated with constructing the Tyler Parkway Embankment concurrent with the Valley Drive Embankment. Subsequently, it is recommended these facilities be implemented concurrently. It is important to note that the Valley Drive Embankment cannot be constructed based on a future installation of Tyler Parkway as under this scenario it would not be in compliance with the NDSE design standards.

MORGAN COURT NORTH AND MORGAN COURT SOUTH

The Morgan Court North and Morgan Court South storm water detention facilities currently consist of low earthen embankments and small diameter culverts. These low earthen embankments are relatively ineffective in reducing peak discharges on Tyler Coulee proper. **Table 7** and **Table 8** list the results from the analysis of the Morgan Court storm water detention facilities under existing conditions without any improvements or modifications.

TABLE 7
Morgan Court North - Storm Water Detention Area
Existing Conditions

Frequency	Peak Discharge (cfs)
2-yr	20
5-yr	49
10-yr	66
25-yr	98
50-yr	125
100-yr	153

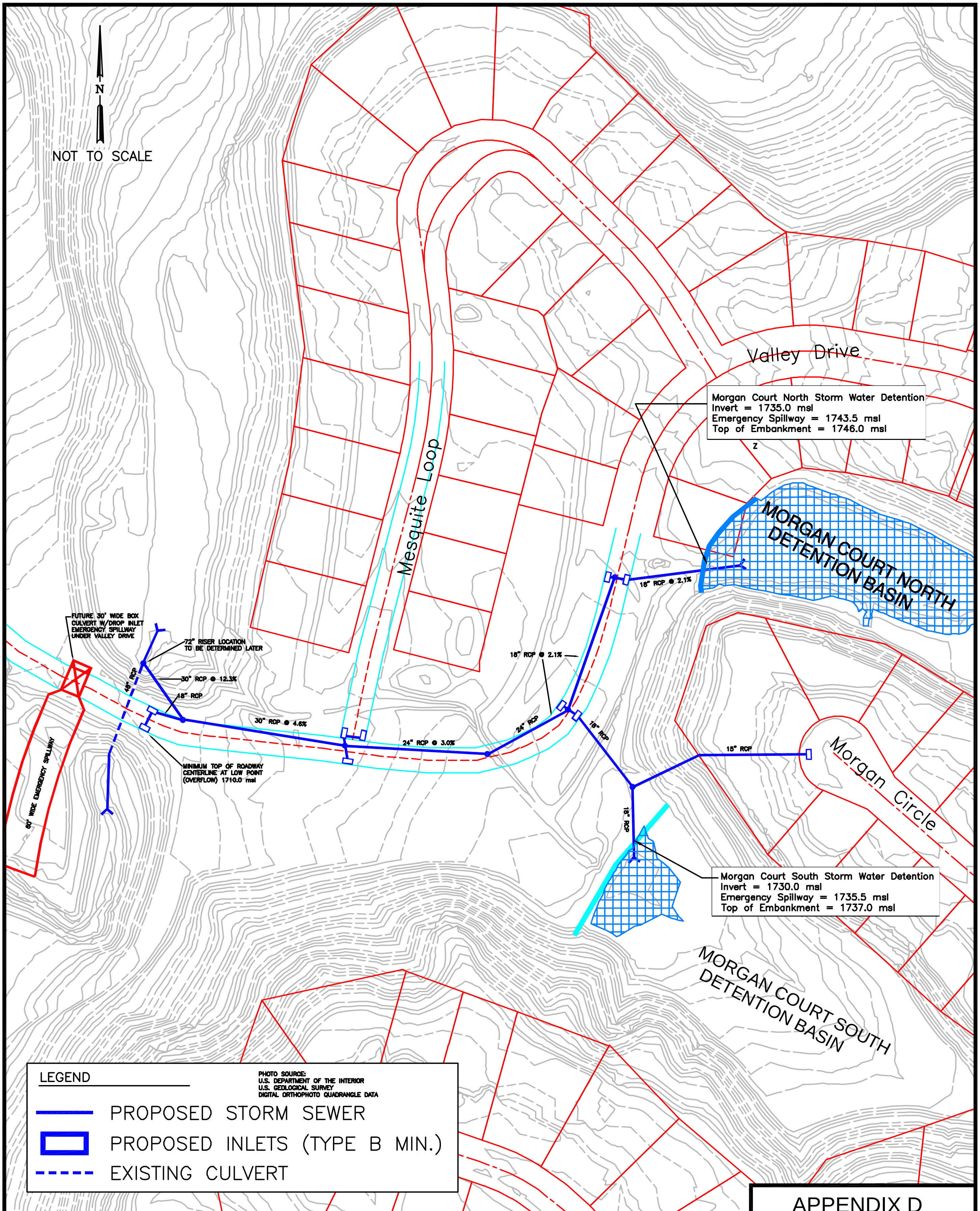
TABLE 8
Morgan Court South - Storm Water Detention Area
Existing Conditions

Frequency	Peak Discharge (cfs)
2-yr	14
5-yr	30
10-yr	39
25-yr	56
50-yr	69
100-yr	83

The Morgan Court Storm Water Facilities are designed to convey upstream storm water inflows in a storm sewer system as development continues along Valley Drive and Mesquite Loop. Thus any reduction in peak discharges is desirable to reduce infrastructure costs and downstream impacts. **Figure Two** illustrates the proposed layout for the Morgan Court Storm Water Facilities and the downstream storm sewers into the Valley Drive Detention Area. The final design of this system was completed by the City and the system constructed in 2004. The following is a summary of the design elements provided for the final design:

MORGAN COURT NORTH

- 18" RCP storm sewer outlet at elevation 1740;
- Open Channel Emergency Spillway at elevation 1748; and
- Minimum top of embankment at elevation 1750.



APPENDIX D

Houston Engineering, Inc. 3712 Lockport Street BISMARCK, NORTH DAKOTA 58501 TEL: (701) 323-0200 FAX: (701) 323-0300	Drawn by: MRS Checked by: MHG	Date: 1-31-07 Scale: NONE	TYLER COULEE WATERSHED POTENTIAL LOCAL DETENTION STORAGE LOCATIONS BISMARCK, NORTH DAKOTA PROJECT NO. 4489-000
			FIGURE TWO

Q:\Projects\Tyler Coulee 4489-000\dwg\T2W Morgan Court Area.dwg-Figure Two-1/31/2007 4:12 PM-(msteele)

MORGAN COURT SOUTH

- 18" RCP storm sewer outlet at elevation 1736;
- Open Channel Emergency Spillway at elevation 1742; and
- Minimum top of embankment at elevation 1744.

Table 9 and **Table 10** list the peak discharges, maximum water surface elevations, maximum storage, and anticipated changes in discharges compared to existing conditions. As shown in these tables, the detention storage provided in these facilities reduces all peak discharges with the greatest decreases occurring on the 100-year event. The information on the 0.5PMP event is provided as information only. Neither of these facilities exceeds the 25 acre-foot NDSE jurisdictional limits and therefore no state permits were required.

TABLE 9
Morgan Court North Storm Water Detention Area
Fully Developed Conditions – Watershed TC3-3

Frequency	Peak Discharge 18" RCP (cfs)	Peak Discharge Emergency Spillway (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	8	0	1741.8	0.9	-12
5-yr	12	0	1743.2	2.2	-37
10-yr	14	0	1744.0	3.1	-52
25-yr	17	0	1745.2	4.7	-81
50-yr	18	0	1746.2	6.3	-107
100-yr	20	0	1747.1	7.7	-133
0.5 PMP	24	473	1749.5	13.2	-169

TABLE 10
Morgan Court South - Storm Water Detention Area
Fully Developed Conditions – Watershed TC3-4

Frequency	Peak Discharge 18" RCP (cfs)	Peak Discharge Emergency Spillway (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	6	0	1737.4	0.3	-8
5-yr	10	0	1738.5	0.6	-20
10-yr	11	0	1739.0	0.8	-28
25-yr	13	0	1739.8	1.2	-43
50-yr	15	0	1740.4	1.6	-54
100-yr	16	0	1741.0	1.9	-67
0.5 PMP	20	296	1743.1	3.6	-4

TYLER PARKWAY

The 2002 Master Plan included a future minor arterial street crossing the Tyler Coulee main channel at Tyler Parkway. This crossing location is also designated in the *Bismarck/Burleigh County Fringe Area Master Plan Report*, incorporated here by reference. This crossing and embankment was included as an integral part of the facilities used to control runoff under fully developed conditions. The following is a summary of the proposed concept plan design elements evaluated for the future Tyler Parkway Roadway Embankment.

- 48" RCP low flow culvert with an invert elevation of 1708.0;
- 10-foot diameter riser with an overflow at elevation 1728.5;
- 6' x 6' RCP Box culvert combining flows from the 48" RCP and riser; and
- Minimum top of embankment at elevation 1741.0.

Table 11, Table 12 and **Table 13** provide the peak discharges, peak water surface elevations and projected storage volumes under existing conditions, intermediate and fully developed conditions with and without this embankment in place. As previously noted, the results indicate that without the Tyler Parkway Embankment the emergency spillway at the Valley Drive Embankment will need to be significantly increased to accommodate future development. Preliminary indications are that the box culverts would need to increase from (3) 10' x 5' RCP to (3) 20' x 8' RCP box in order to handle the additional projected peak inflows under full development without Tyler Parkway.

These tables indicate that, under both intermediate and full development conditions, peak discharges from this facility are generally less than those occurring under existing conditions without the embankment. The critical element in the storm water control function for this facility, are the benefits provided on the 0.5PMP event by reducing facility costs at the Valley Drive Embankment. The Tyler Parkway Embankment was specifically configured for this purpose with no overtopping even though no emergency spillway is included. It was noted during the review process that there were no reasonably suitable locations for an overflow or surface water emergency spillway.

TABLE 11
Tyler Parkway Embankment
Existing Conditions – No Storage or Control

Frequency (year)	Peak Discharge (cfs)
2-yr	99
5-yr	222
10-yr	289
25-yr	407
50-yr	486
100-yr	558
0.5 PMP	2512

Note: Existing conditions do not include the Tyler Parkway Embankment

TABLE 12 **Tyler Parkway Embankment** **Intermediate Development**					
Frequency	**Peak Discharge 48" RCP (cfs)**	**Peak Discharge 10' Riser 6' x 6' Box (cfs)**	**Maximum Water Surface Elevation (msl/NAVD-29)**	**Maximum Storage (Acre-Feet)**	**Change in Peak Discharges From Existing Conditions (cfs)**
2-yr	103	0	1714.1	3.1	+4
5-yr	159	0	1718.4	9.8	-63
10-yr	180	0	1720.5	14.5	-109
25-yr	210	0	1723.9	24.4	-197
50-yr	231	0	1726.7	34.1	-255
100-yr	247	0	1728.8	43.2	-311
0.5 PMP	263	1079	1740.2	131.0	-1170

TABLE 13 **Tyler Parkway Embankment** **Full Development**					
Frequency	**Peak Discharge 48" RCP (cfs)**	**Peak Discharge 10' Riser 6' x 6' Box (cfs)**	**Maximum Water Surface Elevation (msl/NAVD-29)**	**Maximum Storage (Acre-Feet)**	**Change in Peak Discharges From Existing Conditions (cfs)**
2-yr	112	0	1714.7	3.8	+13
5-yr	166	0	1719.1	11.1	-56
10-yr	187	0	1721.2	16.4	-102
25-yr	216	0	1724.7	26.9	-191
50-yr	237	0	1727.4	37.0	-249
100-yr	249	0	1729.2	45.4	-309
0.5 PMP	264	1092	1738.9	117.5	-1156

CLAIRMONT ROAD

The embankments at Valley Drive, Morgan Court, and Tyler Parkway, as well as other smaller storm water control facilities, are all to be designed to reduce full development peaks downstream. Clairmont Road is the last detention control facility and embankment before flows reach Pioneer Park and the Missouri River. This facility was designed to accommodate a 500-year, 6-hour rainfall event without overtopping under existing conditions. The objective at the time of its design was to create a facility with the ability to accommodate future development in the watershed, understanding that additional detention storage would be provided within the individual upstream developments.

Table 14 lists the projected discharges, water surface elevations and storage under updated existing conditions without any modifications at Valley Drive, Tyler Parkway or Morgan Court (Model #1). Based on a top of embankment at elevation 1670.5, significant freeboard is available on a 100-year event. The 0.5PMP event is noted as having an overflow depth of 2.4 feet. In addition, the impacts associated with a breach of the existing and future upstream embankments have been documented. Since this embankment was constructed as a roadway with one culvert placed at the stream bottom and is in compliance with the NDSE/NDDOT Stream Crossing Standards, it is not deemed to be a jurisdictional facility under the State Engineer's regulatory authority.

TABLE 14
Clairmont Road
Existing Conditions (Model #1)

Frequency	Peak Discharge 84" RCP (cfs)	Peak Discharge Overtopping (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)
2-yr	178	0	1652.8	+ 0.3
5-yr	308	0	1655.3	+ 1.1
10-yr	385	0	1656.6	+ 2.0
25-yr	478	0	1658.6	+ 4.5
50-yr	535	0	1660.2	+ 7.6
100-yr	583	0	1661.6	+ 11.2
0.5 PMP	872	2867	1672.9	+ 88.0

Note: Existing conditions do not include modifications at Valley Drive, Morgan Court, or the inclusion of the Tyler Parkway Embankment. Freeboard on the 100–year event is 8.9 ft. The overtopping depth occurring on a 0.5PMP event is 2.4 feet. The top of roadway elevation is approximately 1670.5.

Table 15 provides the projected flows and elevations under updated existing conditions including the initially proposed modifications to the Valley Drive Embankment, the Morgan Court Facilities, and the Pinehurst Square Development (Model #2). **Table 15** illustrates that the proposed improvements to the Valley Drive Embankment, along with the Morgan Court Facilities and the Pinehurst Square Development, result in a measurable net decrease in peak flows at Clairmont Road.

TABLE 15
Clairmont Road - Model #2

Frequency	Peak Discharge 84" RCP (cfs)	Peak Discharge Overtopping (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	178	0	1652.8	0.3	0
5-yr	302	0	1655.2	1.1	-6
10-yr	370	0	1656.4	1.9	-15
25-yr	456	0	1658.1	3.7	-22
50-yr	508	0	1659.4	6.0	-27
100-yr	556	0	1660.8	9.1	-27
0.5 PMP	872	2733	1672.9	88.0	-134

Note: Model #2 includes modifications to Valley Drive and Morgan Court; but no improvements at Tyler Parkway. Freeboard on the 100-yr event is 9.7 ft. Projected overtopping depth on a 0.5PMP is 2.4 feet.

Table 16 provides the results for intermediate development and the addition of the Tyler Parkway Embankment (Model #3). **Table 16** illustrates that adequate upstream controls, including modifications to the Valley Drive and Tyler Parkway construction, will control the projected increases associated with intermediate development within this watershed. In fact measurable decreases in flows will have been achieved by implementing all the upstream master planned facilities. The overtopping depth on the 0.5PMP will also have been reduced to 1.8 feet, compared to 2.4 feet.

TABLE 16
Clairmont Road – Model #3

Frequency	Peak Discharge 84" RCP (cfs)	Peak Discharge Overtopping (cfs)	Maximum Water Surface Elevation (msl/NAVD29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	186	0	1653.0	0.3	+8
5-yr	318	0	1655.5	1.2	+10
10-yr	383	0	1656.6	2.0	-2
25-yr	463	0	1658.2	4.0	-15
50-yr	514	0	1659.6	6.4	-21
100-yr	561	0	1660.9	9.5	-22
0.5 PMP	859	1886	1672.3	80.3	-994

Note: Model #3 includes the proposed modifications at Valley Drive, Morgan Court, and Tyler Parkway with an intermediate level of development. Freeboard on the 100-yr event is 9.6 feet. The depth of overtopping during a 0.5 PMP event is 1.8 feet.

Table 17 provides the results under fully developed conditions including all of the structural features (Model #4). **Table 17** illustrates that adequate upstream controls will have been implemented to control the projected increases associated with development under ultimate development conditions within this watershed. In fact measurable decreases in flows will be achieved by implementing the upstream master planned facilities. Again the overtopping depth on the 0.5PMP will have been reduced to 1.8 feet.

TABLE 17
Clairmont Road
Full Development (Model #4)

Frequency	Peak Discharge 84" RCP (cfs)	Peak Discharge Overtopping (cfs)	Maximum Water Surface Elevation (msl/NAVD-29)	Maximum Storage (Acre-Feet)	Change in Peak Discharges From Existing Conditions (cfs)
2-yr	166	0	1652.6	0.2	-12
5-yr	308	0	1655.3	1.1	0
10-yr	368	0	1656.4	1.9	-17
25-yr	447	0	1657.8	3.4	-31
50-yr	495	0	1659.1	8.0	-40
100-yr	539	0	1660.3	12.5	-44
0.5 PMP	860	1930	1672.3	80.5	-949

Note: Ultimate development conditions include proposed modifications to Valley Drive, Morgan Court and construction of the Tyler Parkway Embankment with the watershed fully developed. Freeboard on the 100-yr event is 10.2 ft. The depth of overtopping on a 0.5PMP event is 1.8 ft.

SUMMARY CONCLUSIONS

Several items were defined through this analysis which the City can utilize to move forward in developing future storm water infrastructure within the Tyler Coulee Watershed. The Valley Drive Embankment will require a minimum top of embankment elevation of 1710.0 and an appropriate emergency spillway configuration. This overflow elevation should be at the roadway centerline and is necessary to provide the minimum allowable freeboard on a 0.5PMP flood event. This increase results in the lowest embankment elevation being raised approximately 1.5 feet from the existing overflow, which is at approximately elevation 1708.5. The size and configuration of the principal and emergency spillways will need to be master planned according to the selected development scenario and time line.

A preliminary design layout for the two Morgan Court detention areas, storm sewers and Valley Drive inlets was provided. This layout was used to prepare the plans and specifications for the street, storm sewer, sanitary sewer and water lines. The best method of lowering the storm sewer flows from the street level into the Valley Drive Detention Area remains to be determined. It was assumed for the purposes of this report that these flows would be contained within the upstream detention area. Street overflow directly onto the slopes or into the emergency spillway section needs to be minimized to prevent undesirable erosion. Connecting the storm sewer directly into the proposed 72" RCP riser section may affect the inflow hydrograph at Valley Drive; however it will not materially affect projected peak discharges.

The SWMM model results indicate the future construction of the Tyler Parkway Roadway Embankment will have a very beneficial economic impact at Valley Drive and will also reduce downstream peak flows. The final embankment configuration will be determined during final design, however, it is notable that the Valley Drive Embankment Spillway can accommodate existing and future conditions utilizing the (3) 10' X 5' RCP Box Culverts only if the Tyler Parkway Embankment is constructed. The proposed Tyler Parkway Embankment section is intended to comply with the NDSE's design criteria without a surface flow emergency spillway. A breach analysis for the embankments within this watershed was also completed to evaluated design standard compliance issues.

VALLEY DRIVE EMBANKMENT – GEOTECHNICAL INFORMATION

A geotechnical evaluation of the Valley Drive Embankment was included in an August 1996 *Engineering Report for the Country West and Pioneer Park Drainage Improvements*. This report was completed by Ulteig Engineers, Inc. for the City of Bismarck and is included in this technical memorandum by reference. The geotechnical section of the report was prepared by Midwest Testing and included recommendations concerning the conditions and status of the Valley Drive Embankment. This information was reviewed in relation to the proposed master plan modifications to this embankment.

Midwest Testing drilled a series of four penetrations along the length of the Valley Drive Embankment. Specific information as to the boring locations was not provided in the report. All four borings penetrated the existing constructed embankment fill and terminated in the underlying natural soils. Based on the documented penetration resistances or "N" values, it appears the embankment was constructed using some form of compaction control. According to the borings the embankment fill ranged in depth from 14 to 24 feet and consisted of a mixture of sandy clay, clayey sand, and sands.

In general the first soils encountered below the embankment fill were fine grained silty sand, with the exception that fat clays were encountered directly below the embankment fill in Boring #19. This was also the deepest portion of the embankment fill, at approximately 24 feet. The silty sands were underlain by lean clay, additional silty sand, and finally fat clay in Boring #17 and #20. The silty sand was underlain by fat clay in Boring #18. Some of the soils underlying the embankment were documented as being somewhat softer than the embankment soils.

Based on our review of the soils report information and additional background data obtained during the 2002 Tyler Coulee Master Plan Evaluation, it is our opinion the Valley Drive Embankment is stable and will continue to function as a temporary impoundment structure in its present condition.

It is proposed the existing Valley Drive Embankment be raised approximately 1.5 to elevation 1810.0. The embankment would be widened to accommodate a future city street section and adjoining sidewalk or pedestrian trail. The embankment side slopes will be flattened from their present 2:1 slope to approximately a 4:1 slope. An extended pipe and riser system will also be installed upstream from the existing embankment. The downstream portion of the spillway culvert will be extended to accommodate the design and construction of the emergency spillway and the prevention of erosion at the outfall and downstream channel.

As previously indicated, the existing Valley Drive Embankment is stable. It is highly likely that consolidation of the underlying foundations has previously occurred. The majority of this settlement is expected to have occurred along the embankment centerline, probably in the area of deepest fill, which is represented by Boring #19 and Boring #20. Little, if any, additional settlement is likely along the centerline with the addition of two to three feet of additional fill and construction of a city street. However, widening the embankment and flattening the side slopes will add significant weight to the foundation soils at or near the base of the existing embankment. Uncontrolled settlement at the base of the embankment (both upstream and downstream) could lead to the development of longitudinal fissures that could adversely impact the overall stability of the embankment. Therefore, it is recommended additional subsurface exploration be completed as part of final design. This would be in the form of additional borings at the existing embankment base, the proposed embankment base, and also in the location of the proposed culvert extension and riser section. These borings should extend a minimum of 30 feet below grade or a minimum penetration of 10 feet into solid or stable foundation soils.

Generally the proposed modifications to the existing Valley Drive Embankment should not pose any significant problems provided proper precautions are undertaken during final design and construction.

A geotechnical evaluation is also required on all future embankments to be constructed within this watershed, the more critical of these being Tyler Parkway, due to the height and width of the embankment. The possible interim construction as a storm water facility followed by its expansion and use as a minor arterial street needs to be included in this investigation. This future use will affect the eventual design width for this structure.

Bismarck

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX E

Jurisdictional Technical Memorandum
Dam Safety and Design Criteria Assessment

APPENDIX E
JURISDICTIONAL TECHNICAL MEMORANDUM
DAM SAFETY AND DESIGN CRITERIA ASSESSMENT
TYLER COULEE WATERSHED

INTRODUCTION

The Tyler Coulee Watershed located in northwest Bismarck, Burleigh County contains a number of existing embankments that are utilized for roadway access and/or as storm water management control facilities. The focus of this Technical Memorandum is to review the jurisdictional issues associated with the North Dakota State Engineer's (NDSE) Dam Design Standards and permitting requirements associated with these facilities. The primary question to be answered is: Which of these facilities are governed by or subject to the NDSE's dam safety regulations? Modifications to existing structures or the construction of new embankments may trigger permitting requirements and compliance with specific design criteria. Compliance with these criteria can considerably increase construction costs and resulting special assessments.

The following is a brief summary of the existing and proposed regional and local storm water detention facilities located within the Tyler Coulee Watershed. The City of Bismarck (City) is evaluating alternatives to manage excess storm water runoff within this watershed generated under existing conditions as well as under future fully developed urban conditions. Therefore, it is anticipated existing facilities will be modified and new facilities constructed to accommodate existing and projected peak flows, runoff volumes and flow durations. In some instances these modifications will fall under the permitting authority of the North Dakota State Engineer as provided in **NDCC Section 61-16.1-38**. Subsequently, compliance with the design criteria outlined in the *North Dakota Dam Design Handbook, June 1985*, incorporated here by reference, will also be required.

Based on our understanding of the regulatory requirements and pursuant to a meeting with representatives from the North Dakota State Engineer's Office, the following comments are provided for each location and are intended to document the anticipated approach for regulatory compliance at each site. The summary table provided at the end of this memorandum contains information regarding the existing and/or anticipated design elements for each facility. While some elements may change during final design and development, such changes are unlikely to affect the determination relative to the State Engineer's jurisdiction and compliance requirements. **Figure One** illustrates the location for each of the major facilities included in the preferred alternative. It should be noted here that the Eagle Crest Embankment while included on the figure is a smaller non-jurisdictional facility. This figure also illustrates the breach zone mapping boundaries. This analysis is discussed further in the master plan report document.

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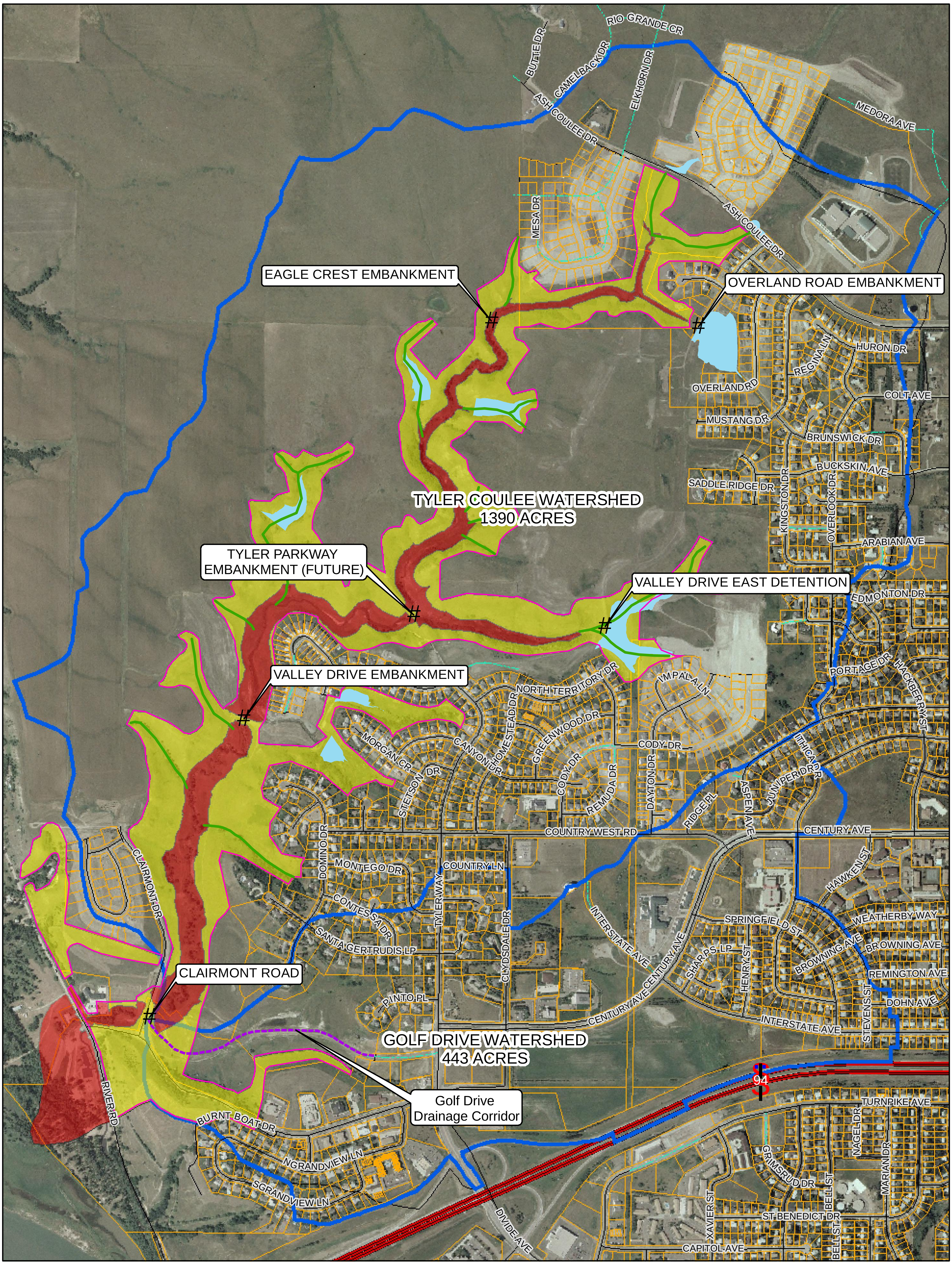

Legend

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

Tyler Coulee Watershed
Stormwater Master Plan
Bismarck, North Dakota

APPENDIX E - FIGURE ONE

3

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Feet

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

TYLER COULEE & GOLF DRIVE WATERSHEDS

Scale:	Drawn by:	Checked by:	Project No.:	Date:	Sheet:
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PREPARED BY
HOUSTON ENGINEERING, INC.
304 E Rosser Avenue, Suite 220 Bismarck, ND 58501
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CLAIRMONT ROAD

This existing city street and Tyler Coulee stream crossing was constructed in 1996. No modifications to this facility being considered or recommended in the Tyler Coulee Watershed Storm Water Master Plan. Based on the NDSE/NDDOT stream crossing standards (**Article 89-14**) this crossing must pass a 25-year rainfall event without creating backwaters in excess of two pipe diameters. Based on the invert of the 84" RCP through this embankment, the maximum allowable headwater is elevation 1664 (1650+2*7). Under both existing and developed conditions, the projected 25-year flood elevation is approximately elevation 1656.0. The existing top of roadway at the street curb line overflow is at elevation 1670, which creates 58 acre-feet of detention storage.

Our analysis indicates this structure is in compliance with the established stream crossing standards and should not be considered a jurisdictional facility. *It is requested that the NDSE confirm this determination.* Even if the State Engineer confirms that the existing structure is not jurisdictional, it is understood that future material modifications to this stream crossing may trigger permitting and/or other review requirements.

While this facility will overtop on a one-half Probable Maximum Precipitation (0.5 PMP) rainfall event (10.5-inches in 6-hours) a breach analysis is not specifically required and was not completed. A breach assessment was conducted for upstream facilities, which are addressed later in this memorandum. The primary impact area from a breach occurring at Clairmont Road includes the Tyler Coulee Channel to River Road, River Road itself and Pioneer Park. The only identified structures affected by these flows are River Road box culvert and possibly the Pioneer Park Sanitary Sewer Lift Station.

The Bismarck Parks and Recreation District recently reconstructed the Tyler Coulee channel beginning at River Road and then west to the Missouri River. This work was funded in part through a grant from the Federal Emergency Management Agency (FEMA). The capacity of the new channel is estimated at around 160 to 190 cfs or roughly a 2-year to 5-year, 6-hour flood event on Tyler Coulee Watershed. This means that flooding in this area will occur during larger runoff events.

VALLEY DRIVE EMBANKMENT

The Valley Drive Embankment is an existing regional storm water detention facility. This embankment contains a 48" RCP principal spillway and, under the NDSE/NDDOT stream crossing standards, must pass a 25-year event without backwaters exceeding two pipe diameters. Based on the 48" RCP's invert, the maximum allowable headwater is elevation 1691.5 (1683.5+2*4). The projected water surface elevation under existing conditions on this event is 1694.3, which indicates this structure is not in compliance with the stream crossing standards. Because the structure is not in compliance with the standards and due to its intended function as a storm water detention facility, this structure would be considered a jurisdictional embankment. Therefore, any modifications to this facility will require that a permit be obtained from the NDSE. Considering its location and downstream conditions, this structure is designated as a high hazard facility and must be designed to accommodate a 0.5 PMP runoff event without overtopping.

The existing top of the Valley Drive Embankment is approximately elevation 1708.5, which equates to at total detention storage of approximately 161 acre-feet. The recommended master plan alternative requires raising the embankment to elevation 1710; extending the existing 48" RCP upstream and downstream to create a minimum 4:1 side slope; installing three 10 foot wide by 5 foot high concrete box culverts with a three foot drop inlet at elevation 1704, which discharge into a 60 foot wide emergency spillway with a gradient of around 3.7 percent. Based on a SWMM Hydrological analysis of alternative upstream watershed development scenarios, it was determined a 0.5 PMP design event, based on master plan conditions, could be conveyed through this crossing without overtopping. The hydrologic modeling results are contained in the *Valley Drive Embankment Technical Memorandum.* These modifications will be completed when the existing embankment is reconstructed as a collector street. The proposed 60 foot top width will accommodate a standard city street section and pedestrian path or sidewalk.

The peak flows obtained from the breach analysis were subsequently utilized to map the downstream breach zone floodplain. The City is proposing to create a non-development zone or green space, within the breach zone to prevent the construction of any structures within this identified special flood hazard area. This action will provide measurable protection to the public downstream from this and other facilities within this watershed.

Another alternative contains a proposal to install a two stage riser on the Valley Drive Embankment Culvert to provide additional control once the contributing watershed becomes fully developed. This is anticipated to occur after the upstream detention storage and storm water controls identified in the master plan have been constructed. The *June 2001 Tyler Coulee Master Plan* called for a 24" RCP with a 72" RCP riser installed to accommodate high flows. The updated master plan evaluation recommends a 36" RCP with a 72" RCP riser.

VALLEY DRIVE EAST EMBANKMENT

The Valley Drive East Embankment located west of the K&L Subdivisions was constructed in 2000 to provide fill and cover for sanitary sewer and water line serving the northern and eastern portions of the Tyler Coulee Watershed (e.g., Horizon Middle School and Mustang Drive Lift Station). This facility was also designed to accommodate a 100-year peak inflow from full developed Watershed TC3-1. This embankment has a 36" RCP principal spillway and estimated storage at the top of the embankment of 30.8 acre-feet. The projected 25-year upstream flood elevation is 1789.1; which equates to around 1.6 acre-feet of storage. The maximum allowable headwater under the NDSE/NDDOT standards is elevation 1790 (1784 + 2*3). Because this crossing is sized in accordance with the stream crossing standards it is not considered a jurisdictional structure and thus no permitting is necessary. *It is requested that the NDSE confirm this determination.* Should this facility be deemed jurisdictional then it may be designated as high hazard and required to pass a 0.5 PMP event without overtopping.

The Valley Drive East Embankment is scheduled to be modified in the future as an extension to Valley Drive, a local collector street. The embankment configuration, spillway system, and limited hydrology are outlined in the jurisdictional summary table.

The City and developers in reviewing this street construction and have considered several options for this embankment should it be determined to be jurisdictional. The first alternative is to lower the embankment to reduce the total storage below the 25 acre-feet, trigger. This, however, would result in more frequent overtopping on this collector street. This is undesirable and not likely to be compliance with the City's street design standards. Overflows on any embankment also represent and unacceptable risk for erosion and damages. The second alternative is to install a secondary overflow structure or spillway culvert to accommodate a 0.5PMP event, which has considerable economic considerations. A third alternative is to optimize storage based on existing topographic conditions and evaluate the potential impacts associated with a breach of this facility. The objective is to design the downstream storage facilities, namely the future Tyler Parkway and existing Valley Drive embankments, to contain a breach of this facility. This approach is similar to that utilized to design and permit the Jackman Coulee/Tom O'Leary storm water detention facility. Essentially the net effect is a determination to reduce the hazard classification for this embankment to allow a lower design standard.

Consideration was given at one time to create a small permanent pool as a natural neighborhood amenity; however, this is not included in the final master plan. This action is likely to increase the probability that the structure is considered jurisdictional. *It is requested that the NDSE provide insight on a potential determination on this issue.*

OVERLAND ROAD EMBANKMENT

The Overland Road Embankment was constructed in 2000 to provide for the installation of a sanitary sewer and water line extension to serve the northern and eastern portions of the Tyler Coulee Watershed. During the development process the landowner/developer also desired to utilize this location as a collector street. The resulting detention storage facility was subsequently designed to accommodate and reduce the 100-year peak flows from a fully developed upstream watershed.

The spillway system for this embankment consists of a two stage inlet with a 24" RCP low level pipe and a 60" RCP riser that discharges into a 36" RCP principal spillway culvert. The total detention storage at the top of this embankment is estimated at around 38.8 acre-feet. The projected 25-year flood elevation upstream is 1840.7, which exceeds the NDSE/NDDOT stream crossing standards (1829 + 4 = 1833). Because this structure does not comply with the stream crossing standards, is capable of storing more than 25 acre-feet and would be considered of either a medium or high hazard, and because the facility was specifically designed for storm water flood control, it is our understanding this may be considered a jurisdictional structure. Therefore, the State Engineer could require a permit be obtained for the structure as it currently exists, and any material modifications would also require a permit. The only anticipated modifications at this time is the construction of the street section to the south; currently the curb, gutter and paving do not extend across the entire embankment.

Under current conditions it is possible the Overland Road Embankment could be considered a non-complying structure given its total storage capacity. The question of jurisdiction was raised to the NDSE in a letter dated January 18, 2000. It was noted in this letter that is was the City's understanding that the NDSE's Office did not deemed this to be a jurisdictional facility. This decision appears based, at least in part, on the scenario that the total detention storage on a 500-year 6-hour rainfall event was less than 12.5 acre-feet. This was the permitting trigger that existed at the time the request was submitted for a jurisdictional determination.

The recently updated SWMM hydrology indicates that the 0.5PMP would result in roadway overtopping at this embankment; however the duration is limited to around 1.5 hours, with a maximum flow of 120 cfs and depth of 0.29 feet. In reviewing the potential jurisdictional issue has considered several alternatives. The first is to lower the roadway and embankment to reduce the storage to below 25 acre-feet. This is not a practical nor reasonable alternative given the existing street is required to service this area and the grading is already established for existing adjacent residential structures. The second was to install a secondary overflow structure or spillway culvert to accommodate the additional flows associated with a 0.5PMP event to prevent overtopping. The third and recommended alternative is to retain the current configuration and evaluate the impacts associated with a breach of this facility. The objective is to design the downstream storage facilities, namely the future Tyler Parkway and existing Valley Drive embankments, to contain a breach of this facility without violating the required design standards. This is the same procedure proposed for the Valley Drive East Embankment and was incorporated into the breach analysis for the downstream facilities. The intermediate land along Tyler Coulee between these structures is designated in the master plan as undevelopable to prevent construction in these flood hazard areas.

TYLER PARKWAY

The *City of Bismarck/Burleigh County Fringe Area Roadway Master Plan* calls for the future construction of an arterial street along the alignment currently identified as Tyler Parkway. This requires the construction of a significant north-south embankment across Tyler Coulee upstream from and east of the Valley Drive Embankment. Due to the nature of this roadway, its location and size it will be a jurisdictional embankment and require permitting. Therefore, the preferred alternative in the master plan outlines this structure to be designed so as not to overtop on a 0.5 PMP event. In fact the intended purpose in this alternative is to utilize the Tyler Parkway Embankment to act at the primary buffering element for the 0.5PMP event. The effect of this is to significantly reduce the flows at Valley Drive and reducing the size of the structural improvements required at this location.

The one disadvantage of this is that the amount of control that can be provided on the smaller more frequent flooding is measurably reduced. While some control can still be incorporated it is necessary to pass a large flow rate in order to contain the projected runoff volumes on the 0.5PMP to prevent overtopping.

As there is no suitable location for an emergency spillway it was necessary to convey all the design flows through a culvert under the embankment. A two stage riser system will be incorporated to optimize the abilities for low flow controls.

Our analysis indicates the recommended structural or design configuration as presented in the master plan preferred alternative is in compliance with the NDSE's established Dam Design Standards. *It is requested that the NDSE confirm this determination and provide any recommendations or comments related to the permit application required for the construction of this facility*.

OPTIONAL STORM WATER DETENTION FACILITIES

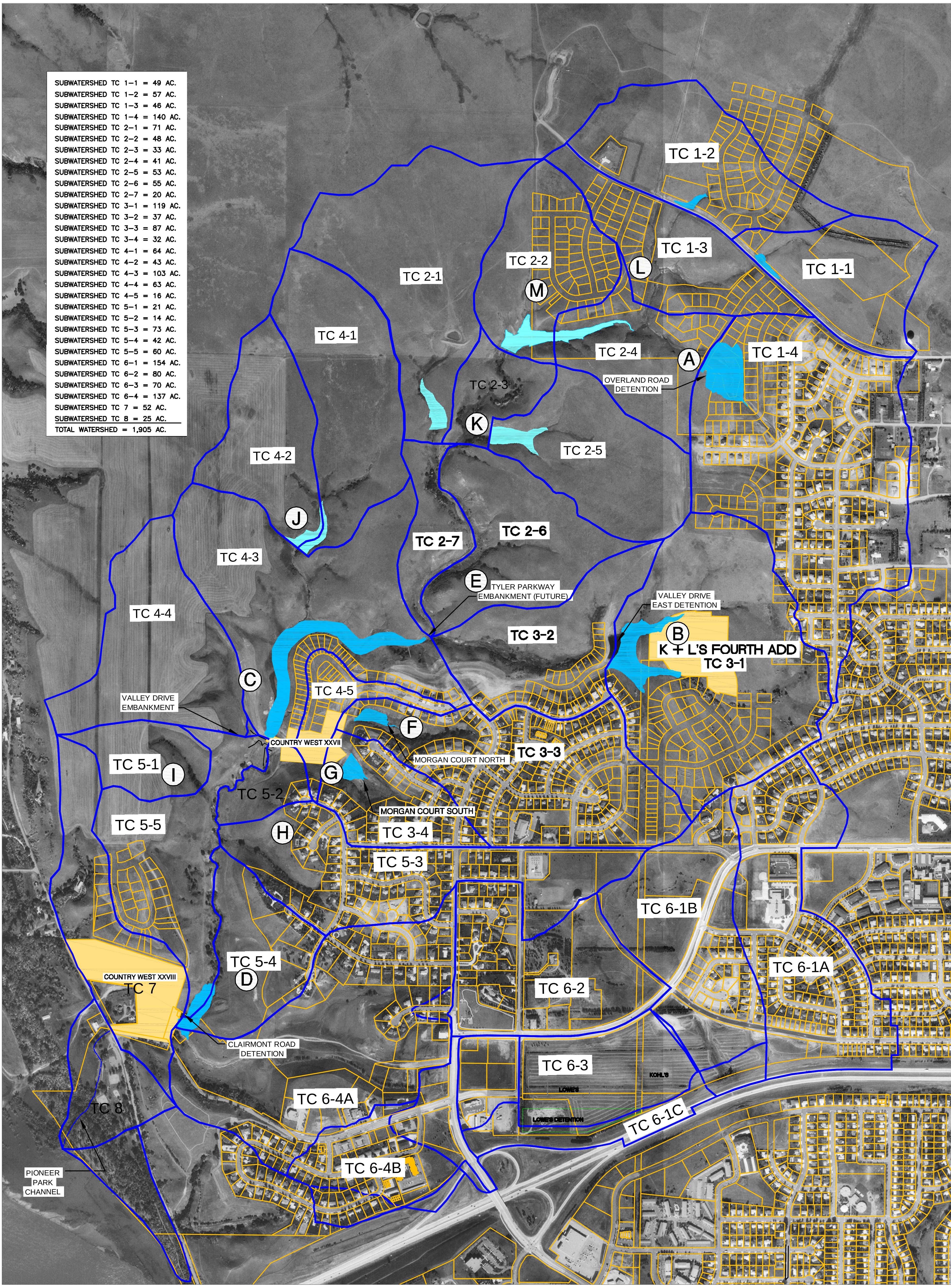
In order to manage storm water runoff within this watershed and to control flows within Tyler Coulee and its tributary channels, a number of smaller detention areas are likely to be constructed in the future. These facilities will be utilized to reduce local flood impacts on the 100-year event, reduce the risk for stream channel erosion on Tyler Coulee or its tributaries and, in some instances, possibly for water quality improvements. Each facility will be designed in accordance with the City's Storm Water Standards and have total storage capacities less than 25 acre-feet, which means they are non-jurisdictional

It is generally anticipated such embankments will not be utilized for roadways, but if they are they will comply with the NDSE/NDDOT stream crossing design standards or have dedicated easements to address the projected impoundment. Most will be located off the primary stream channel and not impacted by a breach or flows from other embankments, with the exception of the previously noted Eagle Crest Embankment. **Figure Two** illustrates the most probable locations for these local detention facilities.

On a related issue, a developer has requested consideration for the installation of a stream crossing downstream or south from Valley Drive and upstream from Clairmont Road. This future street known as Golf Drive will have the following general characteristics.

- Top of the roadway will be at or below the top of Clairmont Road.
- Overtopping will not occur on a 100-year design event pursuant to City's storm water and street design standards.
- The maximum detention storage would be less than 25-acre feet
- This location would be located within the designated breach zone
- An analysis of the crossing has not been completed.

Because the storage capacity, as measured from the top of this embankment, would be less than 25 acre-feet, no permit is required from the State Engineer. *It is requested that the NDSE review this proposed street location and provide any recommendations related to its design or installation.*



SUBWATERSHED TC 1–1	= 49 AC.
SUBWATERSHED TC 1–2	= 57 AC.
SUBWATERSHED TC 1–3	= 46 AC.
SUBWATERSHED TC 1–4	= 140 AC.
SUBWATERSHED TC 2–1	= 71 AC.
SUBWATERSHED TC 2–2	= 48 AC.
SUBWATERSHED TC 2–3	= 33 AC.
SUBWATERSHED TC 2–4	= 41 AC.
SUBWATERSHED TC 2–5	= 53 AC.
SUBWATERSHED TC 2–6	= 55 AC.
SUBWATERSHED TC 2–7	= 20 AC.
SUBWATERSHED TC 3–1	= 119 AC.
SUBWATERSHED TC 3–2	= 37 AC.
SUBWATERSHED TC 3–3	= 87 AC.
SUBWATERSHED TC 3–4	= 32 AC.
SUBWATERSHED TC 4–1	= 64 AC.
SUBWATERSHED TC 4–2	= 43 AC.
SUBWATERSHED TC 4–3	= 103 AC.
SUBWATERSHED TC 4–4	= 63 AC.
SUBWATERSHED TC 4–5	= 16 AC.
SUBWATERSHED TC 5–1	= 21 AC.
SUBWATERSHED TC 5–2	= 14 AC.
SUBWATERSHED TC 5–3	= 73 AC.
SUBWATERSHED TC 5–4	= 42 AC.
SUBWATERSHED TC 5–5	= 60 AC.
SUBWATERSHED TC 6–1	= 154 AC.
SUBWATERSHED TC 6–2	= 80 AC.
SUBWATERSHED TC 6–3	= 70 AC.
SUBWATERSHED TC 6–4	= 137 AC.
SUBWATERSHED TC 7	= 52 AC.
SUBWATERSHED TC 8	= 25 AC.
TOTAL WATERSHED	= 1,905 AC.

N

500 0 500 1000
Scale Feet

LEGEND

= TYLER COULEE SUBWATERSHED BOUNDARY
= EXISTING DETENTION BASIN
= PROPOSED/ALTERNATIVE DETENTION BASIN
TC 6-3 = SUBWATERSHED DESIGNATION

NOTE:
POTENTIAL EXTENDED DETENTION LOCATIONS ARE SHOWN ONLY TO ILLUSTRATE THE TYPE OF SUITABLE TOPOGRAPHIC FEATURES. ADDITIONAL LOCATIONS ARE LIKELY. SPECIFIC LOCATIONS WILL BE DETERMINED DURING PLAT REVIEW BASED UPON A SPECIFIC DEVELOPMENT PROPOSAL.

PHOTO SOURCE:
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
DIGITAL ORTHOPHOTO QUADRANGLE DATA

Houston Engineering, Inc.
3712 Lockport Street
BISMARCK, NORTH DAKOTA 58501
TEL: (701) 323-0200
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MRS	3-29-06
Checked by	Scale
	AS SHOWN

TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA

POTENTIAL LOCAL DETENTION STORAGE LOCATIONS
PROJECT NO. 4489-000

FIGURE TWO

Q:\Projects\Tyler Coulee 4489-000\dwg\Figure Two Potential Detention Sitesdwg.dwg-No Contours-3/29/2006 1:15 PM-(rmteeis)

North Dakota State Engineer Jurisdictional Table

Map Label	Watershed Location	Site Description - Date Constructed	Top of Dam Elevation (msl)	Channel Invert (@ Centerline)	Height (feet)	Storage (acre-feet @ top of dam)	Principal Spillway Pipe Size	Upstream Invert (ft)	25-Yr Flood Elevation	0.5 PMP Flood Elevation	Meets Stream Crossing Standards	State Engineer Jurisdiction
											Y/N	Y/N
Existing Regional Detention Facilities												
A	**TC1-4**	Overland Road Detention - 2000	1856.4	1825	31.4	38.8	36" RCP / 24" RCP	1829.0	1840.7	1857.1	N	**Y**
B	**TC3-1**	Valley Drive Detention East - 2000	1798	1780	18	30.8	36" RCP	1784.0	1789.1	1798.4	Y	N
C	**TC4-3**	Valley Drive Embankment - ?	1708.5	1682.6	25.9	133.3	48" RCP	1683.5	1694.3	1710.0	N	**Y**
D	**TC6-4**	Clairmont Road - 1996	1670.0	1650	20.0	58.0	84" RCP	~ 1650	1656.0	1671.9	Y	N
Proposed Regional or Local Facilities - Preferred Alternative												
A	**TC1-4**	Overland Road Detention - 2000	1856.4	1825	31.4	38.8	36" RCP / 24" RCP	1829.0	1840.7	1857.1	N	**Y**
B	**TC3-1**	Valley Drive Detention East - 2000	1798	1780	18	30.8	36" RCP	1784.0	1789.1	1798.4	Y	N
C	**TC4-3**	Valley Drive Embankment -	1710	1682.6	27.4	161.2	48" RCP / 36" RCP	1683.7	1701.7	1707.9	N	**Y**
D	**TC6-4**	Clairmont Road - 1996	1670.0	1650	20.0	58.0	84" RCP	~ 1650	1657.9	1671.9	Y	N
E	**TC3-2**	Tyler Parkway Embankment	1740.5	1708	32.5	134.0	6'x6' Box / 48" RCP	1708	1724.7	1738.9	N	**Y**
F	**TC3-4**	Morgan Court North - 2004	1746	1735	11	11.9	18" RCP	1735	1739.8	1743.1	na	N
G	**TC3-3**	Morgan Court South - 2004	1737	1730	7	4.6	18" RCP	1730	1745.2	1749.5	na	N
M	**TC2-2**	Eagle Crest Embankment	1798	1778	20	22.8	48" RCP	1778	1782.4	1793.6	Y	N
Potential Local Facilities - Development Driven and Non-Jurisdictional												
H	**TC5-3**	West of Country West Road	1716	1700	16	7.3	na	na	na	na	na	N
I	**TC5-1**	SW of Valley Drive Embankment	1724	1704	20	6.6	na	na	na	na	na	N
J	**TC4-1**	North of Valley Drive	1754	1728	26	12.6	na	na	na	na	na	N
K	**TC2-5**	Country West	1792	1766	26	14.3	na	na	na	na	na	N
L	**TC1-3**	NW of Overland Road	1818	1804	14	6.2	na	an	na	na	na	N

Note: **All elevations are NGDV 1929 Datum**

Bismarck

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX F

Valley Drive Municipal Facilities Memo

MEMO

Utility Crossing Assessment

Houston Engineering, Inc.

3712 Lockport Street
Bismarck, ND 58103-5535

Ph. (701) 323-0200
Fax (701) 323-0300

Date: **March 15, 2006**

From: **Michael Gunsch, P.E.**
Project Manager

To: **Keith Demke, PE**
Director Public Utilities

Subject: **Valley Drive Embankment**
Municipal Utility Crossing

INTRODUCTION

In November 2005 we met to discuss the existing and future municipal utility crossings of Tyler Coulee in the area of the existing Valley Drive Embankment. The City anticipates that a water supply line and a new sanitary sewer line will need to cross Tyler Coulee at this location in order to provide the required municipal services to the developing area north and west of Tyler Coulee. This area includes the recently platted Promontory Point Third Addition.

Originally the City had proposed to cross Tyler Coulee by burying the required utilities within the Valley Drive embankment. This could occur prior to and/or as part of the embankment's ultimate reconstruction as a roadway and flood control facility. This approach to installing these services is complicated by the fact that the current embankment is considered jurisdictional and subject to the State Engineer's responsibility to regulate and permit the construction of dams. As such a construction permit is required from the State Engineer pursuant to NDCC 61-16.1-38 for any modifications to this embankment. These modifications would include the installation of any utilities within the existing embankment, even though the configuration and status of the currently un-permitted embankment would not change. The state is unwilling to separate their jurisdiction from the utility installation if such work results in any modifications to the embankment.

A preliminary concept design was completed for the reconstruction of the embankment, as part of the Tyler Coulee Storm Water Management Plan. This would bring the embankment into compliance with the State Engineer's dam safety requirements. However, the design and reconstruction has not been scheduled, while the City's need to provide water supply and sanitary sewer services across Tyler Coulee is more immediate. Even if the time tables were adjusted so that reconstruction coincides with the utility crossing, the State Engineer's staff has expressed significant concerns related to the risks associated with having a pressurized water main and a sanitary sewer located within this embankment. Dam Safety criteria recommend these utilities not be located with the embankment, and subsequently the State Engineer will not approve such an installation unless it is determined that there are no other feasible alternatives.

The original concept was to bury both the water main and sanitary sewer within the downstream portion of the embankment, with the understanding that the eventual reconstruction would expand the width of the embankment, by adding to the upstream face, to the extent that a breach of the water main or sanitary sewer would no longer constitute a threat to the structure's integrity or a defined embankment core area. This option is only possible with a wider top width as these systems could not be located within the downstream slope itself due to limited accessibility.

The utilities in this proposal would be fully encased and bedded in flowable fill to further mitigate any associated risk. This approach was viewed as being the most economical, even with these requirements, since the line length would be minimized. The future risk for maintenance costs associated with repairing a water main failure in the deeply incised channel would also be avoided. The regulatory issues and concerns associated with this crossing, however, necessitated a closer examination of other alternatives

ALTERNATIVES

The following presents a briefing on the related utility crossing alternatives reviewed as part of this assessment process. These alternatives are illustrated on **Figure One**.

WATER MAIN

WM-Alignment #1 – This original alignment has issues that make it unlikely to be acceptable to the State Engineer without considerable justification related to the dam safety compliance. It is generally understood that if other feasible alternatives exist that the placement of such utilities within the embankment is unacceptable. Since there are other alternatives available and economics cannot be the only factor used for determining feasibility, this alternative is unlikely to be accepted by the State Engineer.

WM-Alignment #2 - Crossing Tyler Coulee utilizing an alignment upstream from the expanded embankment footprint was also reviewed. The primary drawback to this alignment was the anticipated difficulty in construction and future maintenance, due to the deeply incised stream channel and likely need to construct a coffer dam to accommodate base flows in Tyler Coulee. It is also necessary to cross the channel at an adequate distance upstream of the embankment construction limits to ensure that the embankment expansion would not impact the utilities or their accessibility. This was also deemed to be a much higher cost alternative, though we did not evaluate specific pricing issues. It is our understanding, however, that the City may have reviewed several cost opinions.

WM-Alignment #3 – The final alignment ultimately viewed as the preferable route, given dam safety constraints, was to cross Tyler Coulee downstream from the embankment. The advantages include the ability to use the existing embankment as a coffer dam during construction, easier access for future maintenance work, and the fact that this approach would not be viewed as constituting a serious or detrimental dam safety risk. The footprint of the existing and reconstructed embankment could be avoided with this alignment as well. While the future principal spillway extension and new emergency spillway will likely require a casing pipe, these elements would be incorporated into the final system design, either as part of the total reconstruction or as an earlier installation.

SANITARY SEWER

The State Engineer also noted a concern regarding the existing sanitary sewer that is already located within the embankment, see **Figure One**. Given the typical installation and design practices, this system presents an increased risk for piping and a possible seepage failure path under the embankment. While it can remain in place under existing conditions, when permitting is required, relocation of this system will likely be a condition to the final authorization. This system will not be allowed to be abandoned, but actually physically excavated and removed with the excavation replaced with suitable compacted embankment fill.

In discussing the sanitary sewer it appears relocation is in order as part of the reconstruction process and to provide the desired services. **Figure One** illustrates a possible configuration for this relocation; however this alignment is a reconnaissance level assessment as the grades and capacity were not evaluated. It is our understanding there may be issues related to the full use capacity of this system within this reach. Therefore, a capacity analysis for the sanitary sewer system should be completed as part of the relocation design process.

STORM SEWER

There are two storm sewer systems to be lowered from the bluff line into Tyler Coulee. The first entering from the Morgan Court Area to the east is a 30” RCP. The master plan initially called for this storm sewer to be connected into the future riser on the 48” RCP principal spillway; however a more controlled approach to reduce peak flows is to discharge into the inlet structure. The splashing and energy dissipation within this inlet structure, as well as public safety, will be critical issues in the final design configuration. The purpose for this discharge location was to achieve some level of control for local runoff from this area and a secondary control for releases the Morgan Court Detention Facilities. The installation of this storm sewer north of the embankment was completed with the extension of Valley Drive to the eastern abutment of the embankment.

The second storm sewer will enter from the west and will accommodate flows from the 63 acre Watershed TC4-4. There are two alternatives locations for discharging this storm sewer. The first is the discharge upstream into the upstream inlet structure just like the Morgan Court system. Again the sizing and design of this inlet structure requires special considerations. The second alignment would take this storm sewer along the downstream side of the embankment and connect it into the principal spillway location or at a combined plunge pool and outfall. If connected to the system prior to the outfall the pipe size and energy dissipation within the pipe will need to be considered in the design. This downstream location provides a slightly lower measure of control, but has some advantages in lowering the inflow volume on the 0.5PMP event behind Valley Drive.

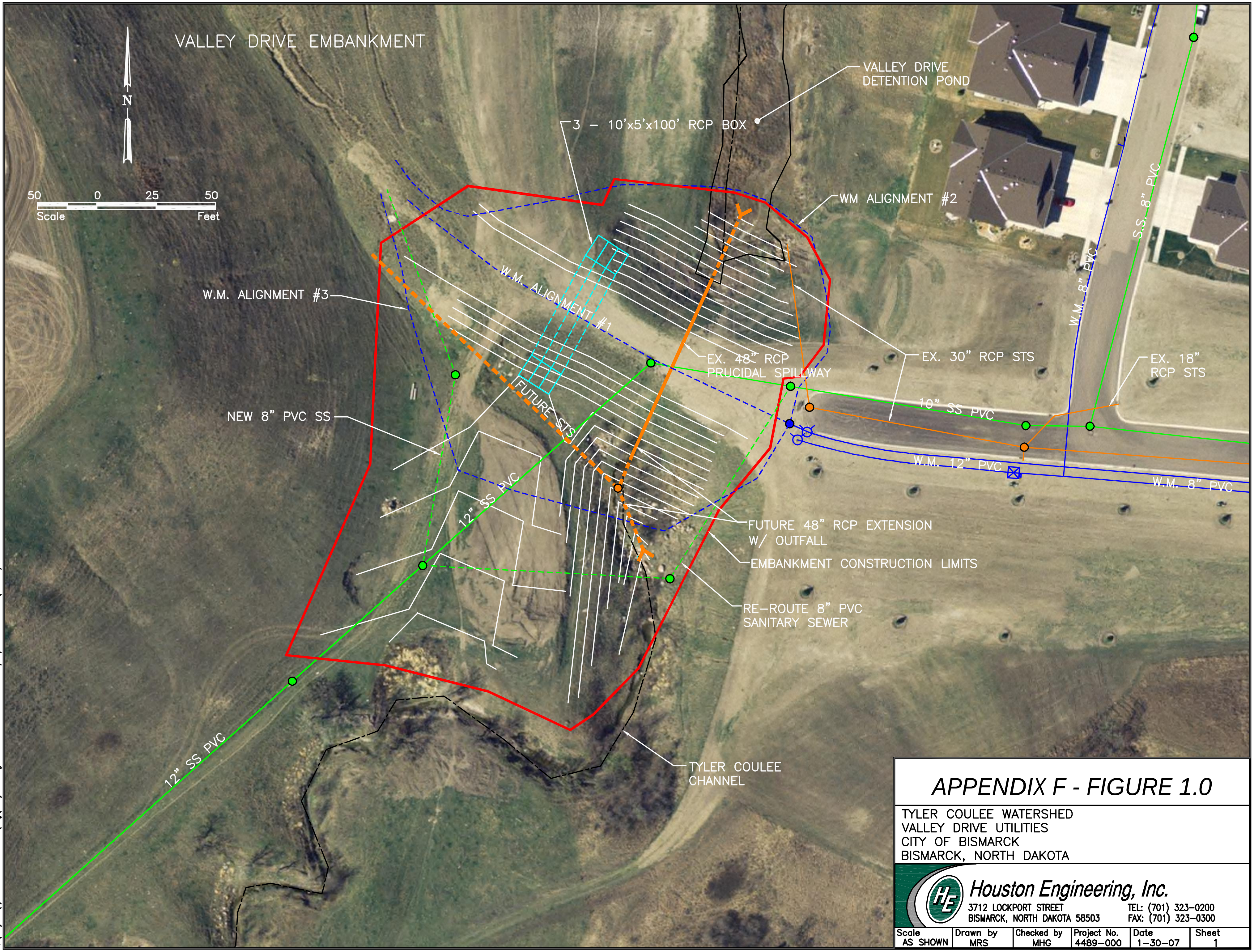
It should be noted for the sake of discussion that the SWMM Hydrology model has both storm sewers being discharged upstream into the Valley Drive Detention. Therefore, any downstream discharge alternative will need to be evaluated during final design. While there will be impacts during some events they may not be significant on the large events. The accommodation of the larger flood flows or surface water conveyance is likely to be a critical design consideration. This is important given the steep slopes in this area, and the need to identify a suitable location that can carry these waters either into the detention area, or possibly the emergency spillway.

Again the storm sewers are like any other utility in that they should be kept in designated locations and not within the core of the embankment section. This is another issue to be addressed in the design, though not as critical as the other systems. Another storm sewer issue is how to address the street flows that need to be accommodated at the low point in the embankment. While the low point is located above the proposed concrete box culverts, the discharge of low flows into the emergency spillway is not desirable and should be avoided. This again is an issue to be considered during final embankment design.

SUMMARY AND CONCLUSIONS

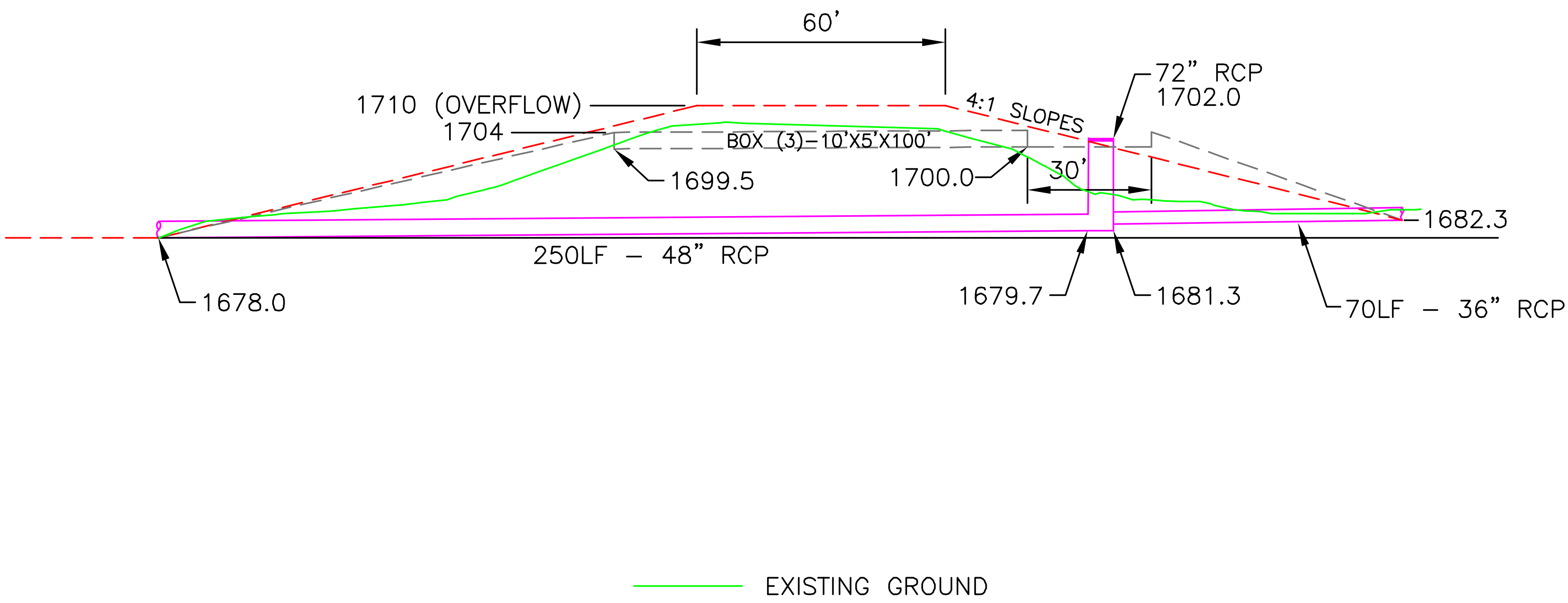
There appears to be a significant value and advantage in concurrently completing the embankment design as part of the water main, sanitary sewer and storm sewer system designs. This would be the case even if the embankment reconstruction were to occur later. Given the pattern of development and the interdependent nature of these systems, it appears reasonable that all these elements should be evaluated and designed at the same time.

This memorandum is intended to document these utility issues and the more notable considerations for each facility. We continue to work on the Tyler Coulee Storm Water Management Plan report and are making progress toward a mid-March completion. As additional information we have included **Figure 2.0** illustrating the typical cross section for the modified embankment, which is to be incorporated into the final report. A copy of the report outline will be forwarded for your review and consideration prior to completing the final draft.



Q:\Projects\Tyler Coulee 4489-000\dwg\valleydrive.dwg-APPENDIX F - FIGURE 1.0-1/30/2007 1:53 PM-(msteele)

VALLEY DRIVE EMBANKMENT TYPICAL SECTION



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TEL: (701) 323-0200
FAX: (701) 323-0300

Drawn by	Date			
MRS	3-21-06	TYLER COULEE WATERSHED CITY OF BISMARCK BISMARCK, NORTH DAKOTA	APPENDIX F - FIGURE 2.0	SHEET
Checked by	Scale		PROJECT NO. 4489-000	1 of 1
MHG	NONE			

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Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX G

Pinehurst Square Development
Site Impacts and Benefits

Tyler Coulee Hydrology Update
November 30, 2004

APPENDIX G
PINEHURST SQUARE DEVELOPMENT
SITE IMPACTS AND BENEFITS
TYLER COULEE HYDROLOGY UPDATE
NOVEMBER 30, 2004

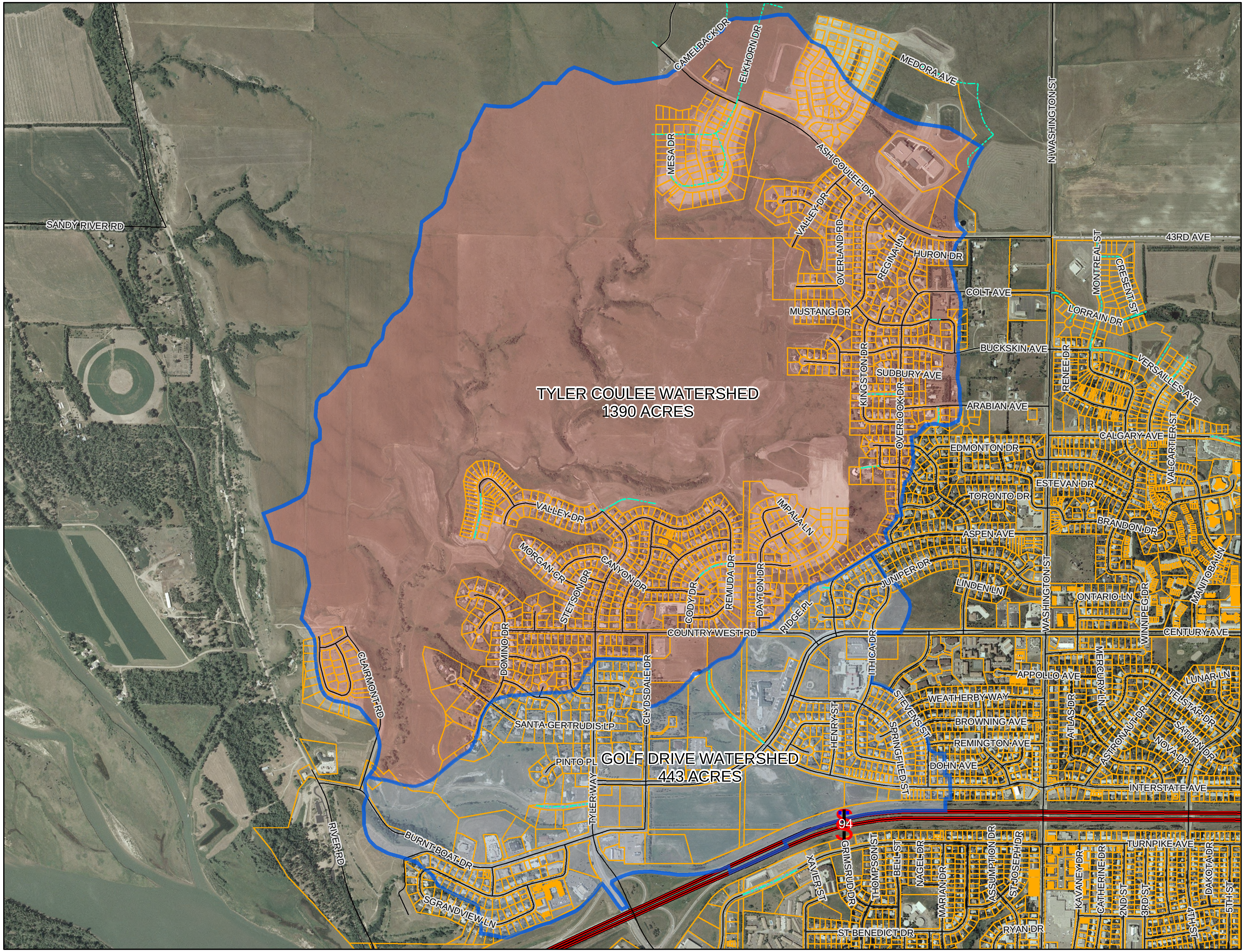
INTRODUCTION

The City of Bismarck (City) recently approved the Woodmont Corporation's Pinehurst Square Addition plat. This plat contains the proposed development sites for the new Lowe's and Kohl's department stores (Lowe's) as well as future retail and commercial development within the Pinehurst Square development. The hydrological analysis for the Pinehurst Square Addition Storm Water Management Plan, prepared by Bartlett and West Engineers, was completed utilizing the NRCS's TR-55 Urban Hydrology Software Program. Subsequently, the City requested the Tyler Coulee Watershed scope of services be amended to include the incorporation of this proposed development including its benefits and/or impacts into the larger SWMM hydrological master plan model. This included an analysis and evaluation of documented downstream issues associated with recurrent flooding within the Tyler Parkway/Burnt Boat Road intersection, potential changes in discharges from the 72" RCP storm sewer outfall into the Golf Drive channel and changes in peak flows at Clairmont Road. These issues were not reported in the Pinehurst Square Addition Storm Water Management Plan.

BACKGROUND:

The Tyler Coulee Watershed contains two primary subwatersheds and conveyance corridors. The majority of runoff is generated by the northern subwatershed flowing in Tyler Coulee, which drains through the future Tyler Parkway, the existing Valley Drive Embankment and Clairmont Road. Runoff generated in the southern, or Golf Drive Watershed, originates along Century Avenue and Interstate 94 and discharges west in the Golf Drive Storm Water Channel. This manmade channel converges with Tyler Coulee just upstream from Clairmont Road where they then drain west into Pioneer Park and discharge into the Missouri River, see **Figure One**.

This technical memorandum focuses on evaluating the Golf Drive subwatershed where existing conditions were revised to reflect recent commercial development and master plan conditions were revised to incorporate the proposed Woodmont Corporation development, (i.e., Lowe's, etc..) in the Tyler Coulee SWMM model. Storm water conveyance systems within this subwatershed were analyzed between Century Avenue and Interstate 94 west to Clairmont Road.



TYLER COULEE WATERSHED
STORMWATER MASTER PLAN
BISMARCK, NORTH DAKOTA

0 625 1,250 2,500 Feet

APPENDIX G - FIGURE ONE

Legend

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

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: 4/15/2005	Sheet: FIG 1

PREPARED BY
HOUSTON ENGINEERING, INC.
304 E Rosser Avenue, Suite 220 Bismarck, ND 58501
PHONE: (701) 323-0200 FAX: (701) 323-0300

Q:\GIS\Projects\Tyler Coulee 4489-000\Tyler Coulee & Golf Drive Figure One.mxd

ANALYSIS:

The primary concern with storm water runoff generated by the Golf Drive subwatershed is the existing and master plan discharges into the Golf Drive Storm Water Channel. This channel has suffered significant damages associated with discharges from existing development. Therefore, at some point, this conveyance facility must be modified to accommodate the master plan flows. This could be in the form of a modified surface water channel, a storm sewer, street flows or some combination thereof. Discharges from the 72” RCP storm sewer outfall, located northwest of the Tyler Parkway and Burnt Boat Drive intersection, were computed for both existing and master plan conditions. The City, as part of the Tyler Coulee Master Plan process, has designated the future conveyance facilities within this corridor as regional. Therefore, the expense required to install a new and/or to modify the existing facilities will be assessed to those properties generating the runoff conveyed by this system. Since the configuration of future development along this corridor has yet to be determined it is anticipated a negotiated distribution of costs between existing and future development will be required. The primary objective is to equalize the costs relative to the benefits provided to the assessed properties.

Lowe’s Development Plan:

The following information was provided in the Pinehurst Square Storm Water Management Plan submitted for the proposed commercial development site:

- Existing Conditions CN = 79, Developed Conditions CN = 94.
- ½ of the 1960’s Jackman Coulee Watershed diversion is upstream = 132 Ac.
- A 42” RCP Storm Sewer conveys runoff through site, Q_p= 100 cfs.
- Q_{100} = 270 cfs, additional flows carried overland via a 54” RCP.
- 54” RCP Storm Sewer, Q_p = 140 cfs, Surface Flows = 130 cfs
- “Confident that reduction from 270 cfs to 100 cfs will be realized.”
- Storage pond discharge pipe is 36” RCP at a 1.5% slope, Q_p = 80 cfs.
- Detention area defined and the storage is as noted in the following table

Pinehurst Square Storm Water Detention Area				
Elevation	Surface Area (sq.ft)	Volume (cu.ft.)	Cumm. Vol. (cu.ft.)	Storage Volume (ac-ft)
1784	76,907	0	0	0.00
1790	125,257	516,492	516,492	11.86
1794	160,485	571,484	1,087,976	24.98

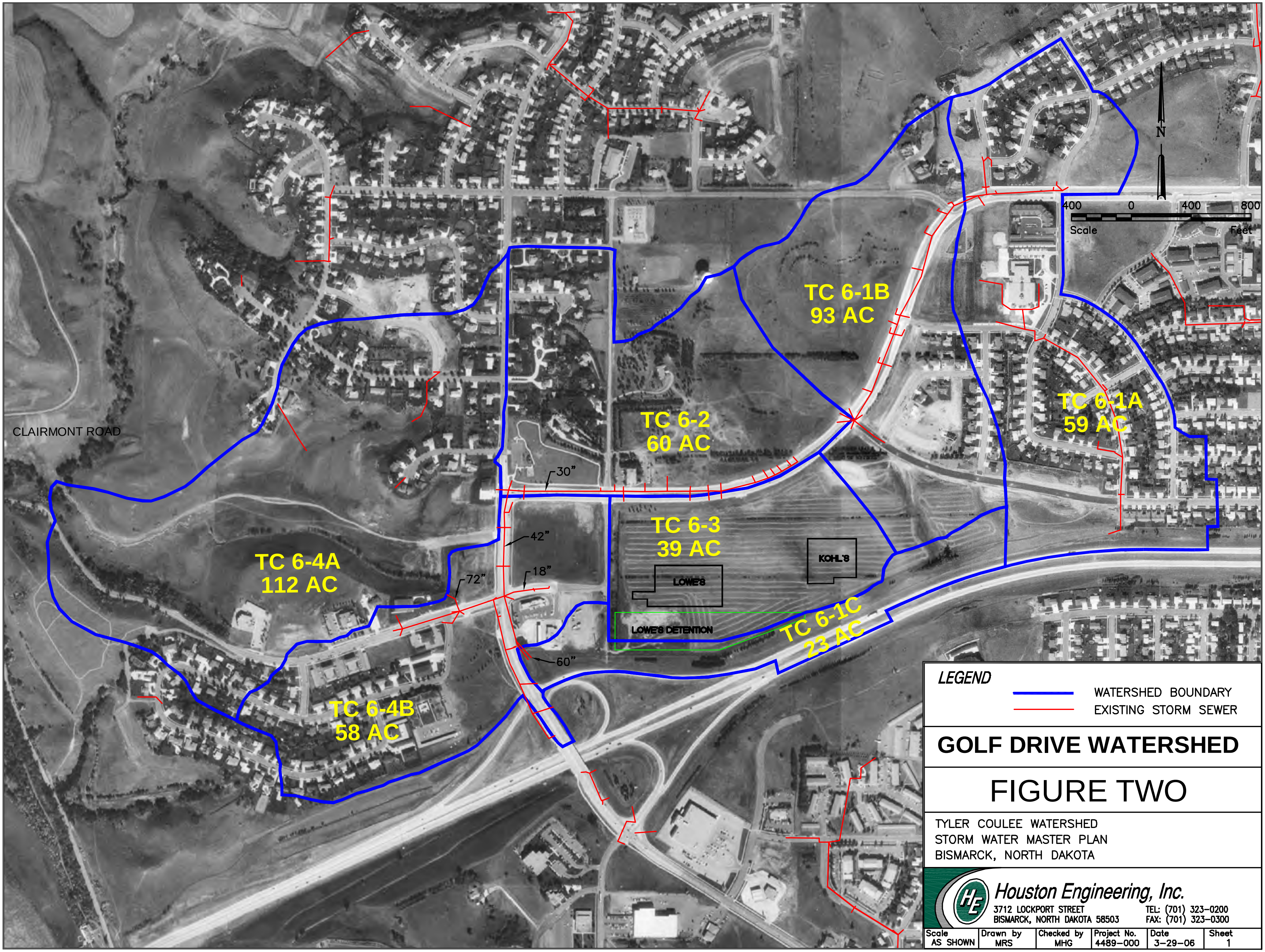
Urban hydrology peak flow computations are typically based on rainfall events having durations similar or equal to the time of concentration of the modeled watershed. As an example the rainfall intensity used in the rational method computations is based on the time of concentration. This practice is also applicable when utilizing other methodologies such as TR-55, HEC-1 or SWMM. The controlling peak flows used in the Tyler Coulee Storm Water Master Plan models were developed using 6-hour rainfall events. It has been shown that under typical urban development conditions the peak flows obtained using this distribution are similar to those using the rational method. The TR-55 analysis for the Pinehurst Square site, however, was completed using a 24-hour rainfall event. This significantly underestimates the peak flows when compared to the 6-hour rainfall event. Subsequently, the following analysis reflects the more critical design event.

Peak flows from Pinehurst Square Detention area are attenuated to the extent that they are completely controlled by the inlet section of the 36" RCP outfall pipe. The resulting master plan discharges are approximately 77 cfs on a 100-year event, or roughly equal to the 80 cfs reported in the site plan. This occurs as a result of detention storage and is not reflective of the peak inflows to this facility. Inflows from the remaining watersheds east and south of the Lowe's site are uncontrolled and projected at around 285 cfs based on a 100-year 6-hour rainfall event. **Table 1** provides the changes in flows associated with the installation of the Pinehurst Square Detention area at the point of discharge. It also provides the projected storage elevations that were not included or reported in the Storm Water Management Plan.

TABLE 1
DISCHARGE FROM PINEHURST SQUARE WATERSHEDS
TC6-1B AND TC6-3
6-HR RAINFALL EVENTS

Frequency	Existing Conditions (cfs)	Master Plan with Pinehurst Square Detention Area (cfs)	Projected Storage Elevation (msl/NAVD-29)	Percent Change Existing to Master Plan
Q_2	106	25	1685.5	- 76%
Q_5	185	48	1686.5	- 74%
Q_{10}	227	57	1687.0	- 75%
Q_{25}	300	66	1687.9	- 78%
Q_{50}	325	72	1688.6	- 78%
Q_{100}	345	77	1689.2	- 78%

The significant reductions in peak flows discharged from the Pinehurst Square Detention system are directly attributable to the controlling of runoff from both Watershed TC6-1B and Watershed TC6-3, which contain a total of 132 acres, see **Figure Two**. The interception of the flows in the 42" RCP storm sewer from Interstate Avenue west of Sharps' Loop is a key component of this system. The overall benefit from this system is a reduction in downstream peaks and the duration of high flows. The invert of the control culvert is at elevation 1684.0, while the proposed top of the control dike is elevation 1694.0 or 4.8 feet above the projected 100-year flood elevation.



GOLF DRIVE WATERSHED

FIGURE TWO

TYLER COULEE WATERSHED
STORM WATER MASTER PLAN
BISMARCK, NORTH DAKOTA

Houston Engineering, Inc.
3712 LOCKPORT STREET
BISMARCK, NORTH DAKOTA 58503
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Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	MRS	MHG	4489-000	3-29-06	1

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As noted, discharges from the Pinehurst Square Detention combine with inflows from the east along the I-94 right-of-way. These waters are then stored and attenuated in the I-94 Detention area. This storage facility was created by the construction of the northeast quadrant of the interchange and off-ramp. The changes in discharges from this location into the Tyler Parkway storm sewer are provided in **Table 2**. This table compares the existing and master plan inflows at the 60" RCP storm sewer inlet. Flow reductions vary with the largest reductions occurring on the more frequent events, while minimal reductions occur on the larger less frequent rainfall events. This detention area also acts as a backwater surcharge area for the Tyler Coulee storm sewer. This is reflected in the changes in floodwater elevations compared to the relative system discharges.

TABLE 2
DISCHARGES FROM THE 60" RCP AT I-94 DETENTION AREA
6-HR RAINFALL EVENTS

Frequency	Existing Conditions		Master Plan with Pinehurst Square Detention Area		Percent Change Existing to Master Plan
	Flow (cfs)	Elevation (msl/NAVD-29)	Flow (cfs)	Elevation (msl/NAVD-29)	
Q_2	34	1673.6	31	1673.5	- 9%
Q_5	75	1675.3	60	1674.4	- 21%
Q_{10}	83	1676.2	71	1675.0	- 14%
Q_{25}	92	1677.2	89	1675.8	- 3%
Q_{50}	101	1677.9	100	1676.4	0%
Q_{100}	106	1678.6	108	1676.8	+ 3%

The SWMM hydrologic model results indicate the detention storage available within the I-94 right-of-way detention area is adequate to control the existing and master plan inflows. This is based on the determination that water surface elevations never exceed the overflow onto Tyler Parkway at elevation 1782 or the low gutter elevation in the Tyler Parkway/Burnt Boat Drive intersection of 1780. Thus the projected runoff from a 100-year rainfall event is contained. This supports personal observations that overflows have not occurred into the Tyler Parkway and Burnt Boat Drive Intersection.

Tyler Parkway and Burnt Boat Drive Intersection:

Inflows at the 60" RCP inlet from the Interstate 94 Detention area combine hydraulically with inflows conveyed by a 42" RCP storm sewer entering the intersection from the north along Tyler Parkway. This system originates as a 30" RCP storm sewer located on Century Avenue. In addition an 18" RCP storm sewer system enters this intersection from Clydesdale Drive to the east. These combined storm sewer systems discharge through a 72" RCP storm sewer, which drains west on Burnt Boat Drive, then northwest into the Golf Drive channel.

The Tyler Parkway and Burnt Boat Drive intersection is documented as suffering from frequent street flooding. On several occasions flood waters have exceeded the street crown, which violates the City's design standards and adversely impacts traffic on this arterial street. Prior to modifying the SWMM analysis it was assumed that this flooding was due, at least in part, to excessive inflows from the I-94 Detention area. Based on the SWMM models, however, this is not the case. While the I-94 system and Pinehurst Square Development contribute to peak flows at this intersection, they do not cause the noted flooding. This determination required a specific hydraulic evaluation of the existing storm sewer configuration into and through this intersection.

Based on the results obtained from SWMM modeling, which accounts for storm sewer system storage and hydraulics, excessive street flows are the cause of the flooding at this intersection. These waters ultimately pond until the storm sewer inlets allow these flows to enter the storm sewer. Numerous storm sewer inlets were provided along Century Avenue as it approaches Tyler Parkway. Storm sewer gradient and capacity issues appear to create a situation where a portion of the runoff remains on the street. While the inlets along Tyler Parkway are designed to collect local street flows they are unable to intercept additional street flows originating on Century Avenue.

Excessive street flows on the south side of Century Avenue also result in a portion of these waters being diverted south onto Clydesdale Drive. Cross flows from the north at this location are also possible due to the steep street slopes to the north. These street flows are then conveyed south and west into the Tyler Parkway/Burnt Boat Drive intersection. While an 18" RCP storm sewer extends a few hundred feet east of this intersection, its capacity to intercept and convey these flows into the primary storm sewer is very limited. Thus street and intersection flooding is compounded by these inflows. It is recommended the City further evaluate modifications to these storm sewers and street sections to resolve this street flooding issue. A review of these issues is not included in the scope of services for this master plan.

Both the storm sewer and street configurations were modeled in some detail along with the Pinehurst Square Development. The purpose was to more accurately depict water surface elevations occurring in the intersection. The 30" RCP storm sewer along Century Avenue was modeled, as was the transition to a 42" RCP storm sewer along Tyler Parkway. Street sections along Century Avenue, Tyler Parkway, Clydesdale Drive and Burnt Boat Drive were also modeled to reflect potential street capacities and storage elevations. Storm sewer inlets along each street as well as within the study intersection were accounted for in modeling total inlet capacity. Insufficient inlet and storm sewer capacity seem to be the greatest issue causing the intersection flooding. Ponding on the 100-year, 6-hour rainfall event is projected to exceed 1.4 feet depth, measured from the gutter in the Burnt Boat Drive and Tyler Parkway intersection. Excess street flows, projected ponding elevations, and water surface elevations within the 72" RCP storm sewer are provided on **Table 3.**

The depth of ponding is projected to increase under master plan conditions due to additional upstream development. The expanded scope of service for this assessment did not include modeling of the MDU Campus or other upstream storm water control facilities. Therefore, these increases could be off-set by on-site detention associated with facilities that are not included in this modeling effort. It is not known if these facilities will reduce the historic flood conditions, but its elimination is unlikely given the magnitude and frequency of its occurrence. It is anticipated that any solution to this issue will require additional modeling and hydraulic analysis outside that requested for this technical memorandum.

TABLE 3
TYLER PARKWAY AND BURNT BOAT DRIVE INTERSECTION
6-HR RAINFALL EVENTS

	Existing Conditions				Master Plan Conditions			
Frequency	Pipe (cfs)	Street (cfs)	WSE (street)	WSE (pipe)	Pipe (cfs)	Street (cfs)	WSE (street)	WSE (pipe)
Q_2	15	0	1780.4	1772.4	32	0	1780.5	1772.2
Q_5	42	0	1781.0	1774.8	64	1	1781.0	1773.5
Q_{10}	57	0	1781.3	1775.6	76	9	1781.3	1774.5
Q_{25}	76	9	1781.3	1776.5	97	22	1781.3	1775.2
Q_{50}	93	20	1781.3	1777.1	110	33	1781.4	1775.7
Q_{100}	108	30	1781.4	1777.7	113	52	1781.4	1776.2

Initially concerns were raised regarding the capacity of the 72” RCP storm sewer to convey excess waters away from this intersection. The SWMM analysis indicates, however, that the 72” RCP is only partially full on the 100-year event, therefore it is technically underutilized. Subsequently, the future capacity of the storm water conveyance along the Golf Drive corridor can be reduced based on the lower projected peak flows. The resulting discharges were reduced nearly 15 percent under master plan conditions. The one exception is the 2-year rainfall event, which is reduced only around two percent. **Table 4** provides the discharge comparisons for existing and master plan flows. It is recommended the evaluation of possible solutions to the intersection flooding be incorporated into the final regional system design. This is necessary since street and storm sewer modifications to reduce intersection flooding could increase peak flows at the 72” RCP storm water outfall. It is also recommended that some form of surface water conveyance be retained along the Golf Drive corridor to accommodate extreme runoff events, or those occurring when the storm sewer inlets are plugged with debris.

TABLE 4 72" RCP DISCHARGES – GOLF DRIVE STORM WATER OUTFALL 6-HR RAINFALL EVENTS			
Frequency	**Existing Conditions (cfs)**	**Master Plan with Pinehurst Square Detention Area (cfs)**	**Percent Change Existing to Master Plan**
Q_2	52	51	-2%
Q_5	113	89	-21%
Q_{10}	126	105	-17%
Q_{25}	138	119	-14%
Q_{50}	146	127	-13%
Q_{100}	154	133	-14%

SUMMARY AND CONCLUSION:

After incorporating the Pinehurst Square Detention area into the Tyler Coulee SWMM model the results indicate the proposed facility, along with the existing right-of-way storage, adequately control runoff from this area and upstream watersheds. The specific downstream impacts resulting from the Pinehurst Square Development, however, were not reported in the modeling analysis completed for the initial site plan. The initial storm water system analysis also did not evaluate how the extensive development would impact and/or benefit the regional system. The conclusion of the initial storm water analysis was that master plan discharges were significantly less than those under existing conditions. This technical memorandum completed the evaluation of the downstream impacts and provides direction as to the future design parameters for the Golf Drive regional conveyance system.

Additional system modifications to further control runoff from the Pinehurst Square and I-94 detention areas are possible; however evaluating numerous alternatives is outside the scope of this investigation. Several possible alternatives include, but are not limited to, reducing the 36” RCP outfall at the Pinehurst Square Detention area and/or limiting inflows into the 60” RCP using a two stage riser. The later option was included in the 2000 Tyler Coulee Master Plan Report. Based on the additional information obtained during this investigation, this system may not be required; therefore, consideration as to its benefits and cost should be evaluated during final design. While these alternative actions will reduce discharges at the 72” RCP outfall, they will not resolve recurrent flooding in the Tyler Parkway/Burnt Boat Drive intersection.

An opinion of probable cost for the Golf Drive regional system was developed utilizing the 1996 design features, less items related to local development and previously installed. While peak flows are reduced, the general layout and configuration of this system does not significantly change. The 1996 system consisted of a narrow surface water rock lined channel. The projected velocities occurring within the proposed channel raise serious concerns relative to channel stability and maintenance. During this investigation it was determined that a storm sewer option exists that has a slightly lower cost and far fewer maintenance issues. This issue is addressed in a separate technical memorandum as are the impacts at Clairmont Road.

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX H

Development Control Line

APPENDIX H
TYLER COULEE DEVELOPMENT CONTROL LINE
OCTOBER 25, 2004

This appendix provides information regarding the methods utilized to establish a Development Control Line (DCL) within the Tyler Coulee Watershed, Bismarck, North Dakota. The DCL and the resulting restricted zones or undevelopable properties (i.e., breach zone and/or steep slopes) as well as the limited development zones, (i.e., green space), is included in the scope of services for the Tyler Coulee Watershed Storm Water Management Plan. The description of the proposed DCL was developed through prior experience, research and input gathered during the Tyler Coulee Citizen Work Group meetings. These work groups were formed by the City to obtain citizen input on this project consisted of interested local residents living within the watershed.

The first step was to utilize a GIS data analysis on the Tyler Coulee Watershed to determine potential non-development zones and/or undevelopable properties. The analysis consisted of testing for a number of issues. The results were then illustrated by a series of maps made available to the City for review. Several factors determined where the final DCL should be established. The following points describe these factors and the methods used:

Topography

- The natural topography was the primary factor in determining an applicable location for the DCL. Steep slopes of more than three feet horizontal and one foot vertical (i.e., 3:1 or 33%) are typically unsuitable for development or would require extensive re-grading. This grading tends to result in slope instabilities along the stream channel, as well as an increased potential for settlement and/or slope failure. As a result soil stability and erosion on these steep slopes are critical issues to storm water management and water quality concerns. These steep slopes are difficult to maintain, and re-establishment of vegetative cover is problematic even with native plant species.

- Using the City of Bismarck's two foot GIS contour data, a Digital Elevation Model was generated using ArcInfo. Shaded relief and slope surfaces were then created using Spatial Analyst to aid in the visualization of the topographic variations. While reviewing the three dimensional surface, a natural break line was clearly visible in many areas indicating the bluff areas surrounding the coulee. The slope surface indicates that many of these bluff areas have slopes in excess of 3:1, with many areas in the range of 5:1 (20%),

- Considering a maximum allowable street gradient of 10% the utilization and/or development of areas having slopes of up to 10:1 is limited. Such areas typically are developed into larger lots or the slopes used for rear yards on residential lots. Subsequently, in certain areas, the DCL was established at a variable distance from the designated steep slopes. This varied from sixty to eighty feet; however, since the DCL is defined as a flexible boundary these areas only require special consideration as part of the development process. The City can then determine, in the best interests of the public, which areas are not suitable for development. The DCL was also adjusted to provide a reasonable connectivity between topographic features within the watershed.

A number of secondary considerations were also included in evaluating the possible location and DCL definition. While these are typical issues related to establishing such control lines and/or green space requirements, they were less of a factor in this watershed. The exception is the floodplain and breach zone as described later.

Shoreland or Riparian Buffer

- Maintaining riparian and/or wetland areas along a stream is an important part of sustaining water quality and preserving the ecological health and aesthetic appeal of an area. Establishing a suitable or acceptable stream buffer along the main channel and its tributaries is important. While several lines were generated in ArcView to indicate these riparian areas this buffer typically fell well inside or overlapped the areas of steep slopes. Therefore, the stream channel and riparian buffer line were not critical in establishing the DCL.

Existing Vegetation

- Existing vegetation can be very important in determining the location for a DCL. During previous and current planning efforts land owners and residents expressed an interest in maintaining the large oak trees and the open or green space to preserve the general character of Tyler Coulee Valley. Vegetation also helps to prevent erosion and enhances the aesthetics of the overall community. The 2001 City of Bismarck Orthophotos were used to determine areas of natural vegetation. Subsequently, areas of visible vegetation were digitized off of these photos using ArcView. Again the majority of these areas were located within the areas of steep slopes or floodplains.

Existing Parcels and Plats

- The City of Bismarck GIS Parcel Data shape file was also used to aid in establishing the DCL. This information was supplemented by more recent plats not currently included in the GIS system. They included the subdivision plats for Horizon Heights, Eagle Crest, K&L's Fourth Addition, Country West XXVII and Country West XXVIII. The existing platted property line or edge of these existing residential parcels made a logical boundary. These parcels were avoided so as not to place any additional restrictions on currently platted properties. While the City may have or could chose to assume some level of jurisdictional control over these areas, not exercising this authority prevents unnecessary public confrontation. The undeveloped properties are considered the principal areas where preservation and protection can and should be provided prior to future development. This action is considered in the best interest of the public and is also governed, in part, by the City's Storm Water Management Ordinance. The need for new ordinances was considered, but specifics were not discussed.

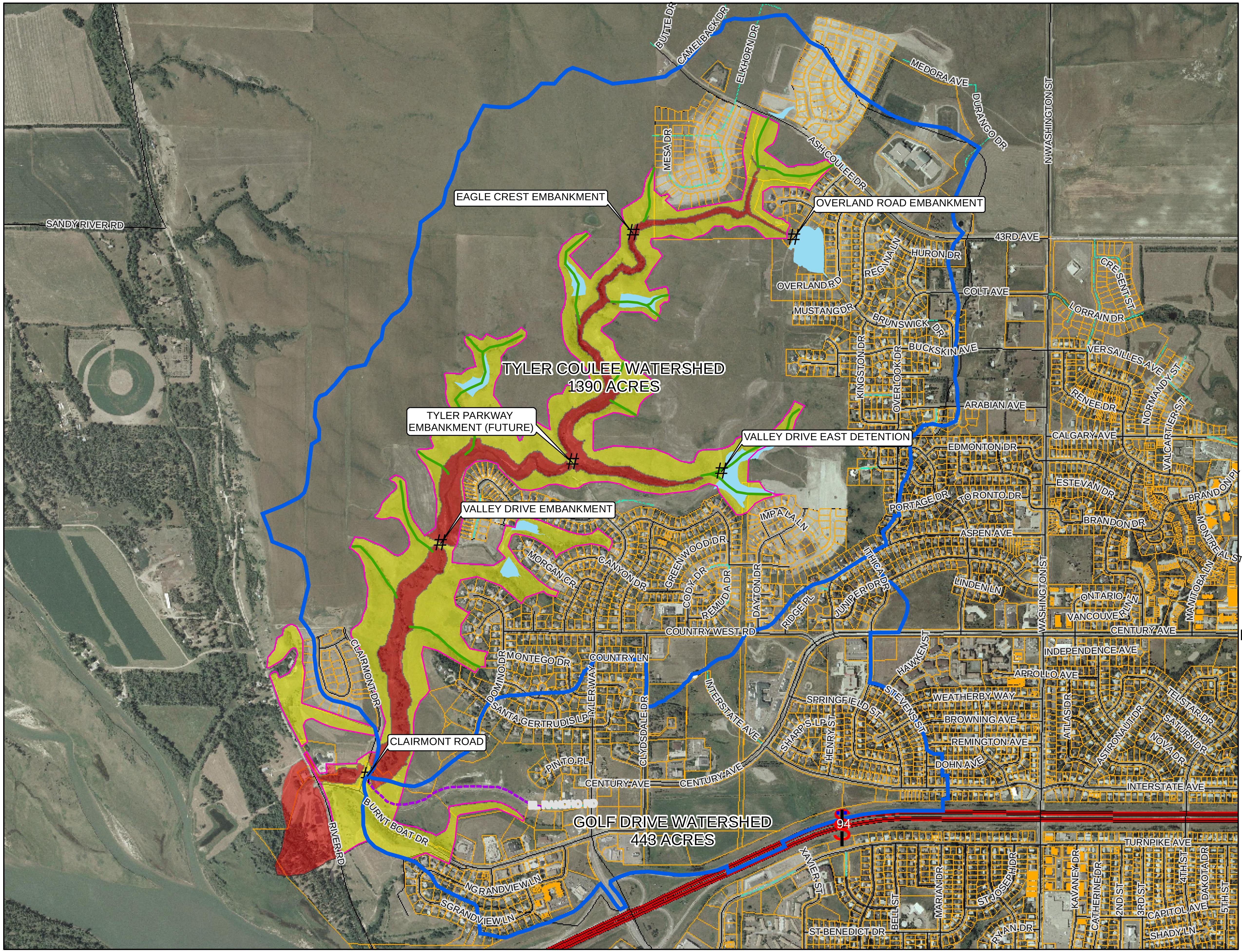
Flood Plain and Breach Zone

- The second primary factor in establishing the DCL within the Tyler Coulee was the floodplain and breach zone boundaries. Typically floodplain mapping is based on a 100-year flood event, which is used to govern or control development with the designated special flood hazard area. The Tyler Coulee Storm Water Master Plan, however, calls for the modification and/or construction of sizable detention facilities. Several of these are jurisdictional structures regulated by the North Dakota State Engineer (NDSE). Subsequently, these embankments are designated as high hazard facilities and must be designed in accordance with the NDSE Dam Design Standards. As such a breach analysis is required to determine the downstream flood impact area or Breach Zone. The resulting boundary has been defined and no future development is to be allowed within this area, with few exceptions.
- In addition to the breach zones the floodplains upstream from the proposed local detention facilities are also mapped as non-development areas. These areas are shown as an effective flood zone and development will be restricted.

The final recommendation for the location and mapping of the DCL is provided on **Figure One**. This DCL boundary will be provided as a shape file for use in the City's GIS system to regulate future development within the designated areas.

As part of the Alternative Work Group discussion process, the City presented and subsequently revised a definition and description of a two tiered DCL. The following is a summary of the recommended language to be incorporated into the Tyler Coulee Storm Water Master Plan.

Tyler Coulee Watershed
Storm Water Master Plan
Bismarck, North Dakota



0 345 690 1,380 2,070 2,760
Feet

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

APPENDIX H - FIGURE ONE
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: AS SHOWN	Drawn by: MRS	Checked by: MHG	Project No.: 4489-000	Date: 3-28-06

Houston Engineering, Inc.
3712 LOCKPORT STREET
BISMARCK, NORTH DAKOTA 58503
TEL: (701) 323-0200
FAX: (701) 323-0300

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DEVELOPMENT CONTROL LINE

It is recommended that the City of Bismarck (City) establish a Development Control Line as part of its storm water master planning process to control development along watercourses and within their associated floodplains. This will be accomplished through the creation of a two tiered DCL defined and managed as follows:

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.

- Encroachment into Tier One will only be allowed for the 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 a watercourse or within the watershed identified as not being in the best interest of the public to be developed. These areas are typically defined as those located within the floodplain 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:
  - Placement of fill material within a floodplain, watercourses 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 permit this reduction must be offset by the developer.
  - 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 shall be provided to the City 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 or environmentally sensitive properties.

- These and related issues will be reviewed and considered via storm water permits submitted for development.

The City <u>may</u> 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 be either on site construction or as a financial contribution to other existing and/or yet to be determined facilities. The City will develop a method to account for losses in conveyance and/or storage if encroachment is to be considered. Any expenses incurred for work within the DCL would the sole responsibility of the developer.

It should be noted that the final revised version of this DCL definition is incorporated into Section 4.9 of the Master Plan Report.

MAPPING AND WAIVERS

The DCL shall be shown on all preliminary and final plats, in watersheds where it has been established via a storm water master plan study. The master plan DCL shall be based on a line drawn to specifically define the Tier One area, while the Tier Two limits will be approximated based on the best available data.

Since the City deals mostly with new plats, the process for requesting waivers already exists. This shall be accomplished through the pre-screening review process and public hearings before the City Planning Commission and City Commission. Approval via platting will re-establish the Tier Two boundary at the edge of newly platted lots. The Tier One location will not change unless a wavier request is approved by the City Commission. Waivers for encroachment into Tier Two will be reviewed and approved by the City Engineer.

CITY ACTION/RESPONSE

The Tyler Coulee Watershed Storm Water Management Plan and all future storm water master plan reports will designate the location of the regional and local systems as well as define a Development Control Line, where applicable. Existing storm water master plan reports will be reviewed for the purpose of establishing the location of regional and local systems. These reports or summary information will be presented to the City Commission for their acceptance.

It is anticipated that revisions to the City's Storm Water Ordinance and Storm Water Design Standards Manual may be implemented to further address the Regional and Local system designations and the establishment of the DCL in Tyler Coulee and other watersheds throughout the community.

Tyler Coulee

Storm Water Master Plan

City of Bismarck

APPENDIX I

Tyler Coulee Watershed Preferred Alternative
Engineering Opinions of Probable Costs

APPENDIX I

TYLER COULEE WATERSHED PREFERRED ALTERNATIVE
ENGINEERING OPINIONS OF PROBABLE COST

The engineering opinions of probable costs, at the end of this appendix include those items anticipated to be incorporated into the Preferred Alternative for the Tyler Coulee Watershed. The Preferred Alternative facilities listed are not the same as those outlined in the 2002 Master Plan, as it was prepared prior to the State Engineer's jurisdictional determination and contained references to local infrastructure elements. The following is a brief summary description of each existing or proposed facility. The baseline cost opinions presented are based on a broad approach to estimating based on information currently available and updated to projected 2006 prices. These costs can be significantly impacted by economic conditions at the time of construction, geotechnical information obtained during final design, final permitting requirements from state and/or federal agencies and other unknown factors.

CLAIRMONT ROAD

This is an existing city street constructed in 1996-1997, which has been designated by the City as a regional detention facility. No modifications are anticipated and/or deemed necessary for this facility to comply with full master plan development. Therefore, no costs associated with this regional feature are included; however, it is incorporated as part of the Preferred Alternative as a primary storm water control facility and will have future maintenance costs.

VALLEY DRIVE EMBANKMENT

This existing regional detention facility requires significant modifications in order to bring it into compliance with the North Dakota State Engineer's (NDSE) Dam Design Standards. The primary reason to modify this facility, out side of flood control, is related to providing street access to the west side of Tyler Coulee. The anticipated costs include widening the embankment and re-grading the upstream and downstream slopes to accommodate the future roadway section, emergency spillway construction and principal spillway inlet modifications. The expenses associated with street construction or other features to serve future development, such as sewer, water, sidewalks etc., are not included in the regional system costs. The cost to widen the embankment and install the emergency spillway box culverts is included, however, as this is a structural issue associated with NDSE compliance.

Based on the NDSE criteria this embankment is a high hazard facility. This relates to its location and the risks associated with its potential failure. Subsequently, this facility must be designed to accommodate a 0.5 Probable Maximum Precipitation (0.5PMP) event without overtopping the embankment and include a structural spillway to protect it against erosive failure during this event.

These requirements significantly increase the projected cost for this facility compared to those presented in the 2002 Master Plan. Issues related to future municipal utilities to be installed in the area of this embankment are discussed in **Appendix E**.

TYLER PARKWAY EMBANKMENT

The proposed Tyler Parkway Embankment is the designated stream crossing location for a future minor arterial street pursuant to the *City of Bismarck's Fringe Area Roadway Master Plan*. While this embankment is required for transportation purposes, it will also be utilized as a regional detention facility. Again, based on the NDSE criteria, this embankment is designated as a high hazard facility. Subsequently, it was determined during the hydrologic evaluation that its primary detention value is to assist in controlling the 0.5 PMP rainfall flood event. This based on an analysis indicating that measurable cost savings could be achieved in the Valley Drive modifications if this facility was design to control this event. Subsequently, it was determined these savings are best applied toward installing that portion of Tyler Parkway attributable to storm water management since they represented roughly one-half of the cost for this embankment.

The projected costs in the Preferred Alternative include only that portion of the embankment necessary for storm water control and not the wider section required for street construction. Therefore, this is a narrower embankment at a single elevation without a vertical curve for the street. This facility is sized based on the SWMM hydrological analysis for master plan conditions described in **Appendix D**. It will also be designed to accommodate a breach of upstream structures without overtopping.

A review of the previously projected street gradient for Tyler Parkway indicates the low point in the street was approximately 1741. The gradient entering from the south was estimated at 7.9%, while the gradient to the north was around 4%. Due to the flood control and storage requirements, as well as overtopping criteria, this low point elevation must be raised to elevation 1844. This will provide for a slight reduction in gradient into and across this embankment or around 7.5% and 3% respectively.

VALLEY DRIVE EAST EMBANKMENT

This is an existing regional storm water detention facility that may need to be modified to meet the NDSE's design criteria. While this issue is under review, the anticipated change to achieve compliance is the construction of a structural emergency spillway. The opinion of probable cost includes the installation of a secondary storm sewer spillway to prevent overtopping on the 0.5PMP event.

Though an opinion of probable cost is provided for this facility these expenditures may not be required. It has been suggested that this embankment be lowered below the NDSE's 25 acre-feet jurisdictional limit. The ability to complete this modification has not been confirmed, nor is it advisable given the steep gradient of the downstream face. Overtopping of this embankment is an undesirable situation under any event. In addition the need to control discharges from the upstream watershed without overtopping on large runoff events should be the guiding factor in this decision.

This embankment was originally constructed without utilizing a storm water improvement district (SID). It was constructed for the purpose of covering a proposed sanitary sewer and water main extensions to service the north and eastern portions of the Tyler Coulee Watershed. The expenses associated with future street construction over this embankment are not included.

EAGLE CREST EMBANKMENT

This is a proposed new regional detention facility. Its installation is necessary due to the size of the upstream watersheds and the need to control flows and velocities within the main Tyler Coulee channel to limit and/or prevent erosion, as well as to control the more frequent runoff events. This embankment will be used principally for storm water control within the channel and is not sized nor configured for use as a roadway or street. In addition this facility adds flexibility to the phasing of future upstream development within the watershed.

OVERLAND ROAD EMBANKMENT

This is an existing regional storm water detention facility that may need to be modified to meet the NDSE's design criteria. While this issue is under review the anticipated change to achieve compliance is the construction of a structural emergency spillway. The opinion of probable cost includes the installation of secondary storm sewer to convey excess flows overtopping the roadway on the 0.5PMP event. While this issue is still under consideration, the costs are included to address this issue should it be deemed necessary.

It is anticipated that Valley Drive, which is the street located on the embankment is slated for extension to the south in 2006. This would occur in conjunction with the development of the proposed platting and construction of the Country West XXVIII addition. This preliminary plat has been submitted to the City for consideration. It should be noted that the construction of this street on the embankment is likely to require permitting through the NDSE. The reasoning is that a permit is required for modifications to any storage facility capable of retaining more than 25 acre-feet of water, which this embankment does, and therefore the proposed modifications may trigger compliance with the regulatory requirements.

GOLF DRIVE STORM WATER CONVEYANCE CORRIDOR

The Golf Drive Watershed is located in the southern portion of the Tyler Coulee Watershed. This watershed is easily discernable from the primary Tyler Coulee Drainage in that it has its confluence with the drainage from the north at Clairmont Road. It is clear that runoff generated within this watershed does not flow through the other master plan features. Therefore, no impacts or benefits result or are provided by the other Preferred Alternatives facilities.

The missing link in this situation is the required facility to convey waters through the Golf Drive Corridor from the Burnt Boat Road/Tyler Parkway Intersection west to Clairmont Road. This is currently being accommodated by a storm water channel located outside the easement obtained for its conveyance. This relocation was completed at the option of the landowner; therefore the risks associated with this action may also transfer. The City has been taking care of this channel through its annual operation and maintenance activities or with FEMA disaster funds, when available.

The estimated costs to construct the conveyance and/or storage facilities within this corridor are highly dependent upon the allowable development. To attempt to resolve the question of probable costs it was determined that the utilization of the facilities proposed in 1996 be used to project costs. The 1996 storm water conveyance facilities included a narrow rock riprap lined surface water channel, a rock drop structure, as well as limited storm sewer and related surface improvements. During the analysis of the Pinehurst Square Addition and Tyler Parkway/Burnt Boat Road intersection, it was determined that the flows discharged from the 72" RCP outfall into this conveyance corridor were less than those outlined in the 1996 plans. Therefore, a secondary review was completed to evaluate a possible storm sewer alternative. This lead to the conclusion that a 48" RCP storm sewer system, combined with a secondary surface water overflow channel could accommodate the projected flows. While the cost for this option is slightly higher it provides a much more stable project with significantly reduced operation and maintenance costs, and therefore was utilized in the preferred alternative.

As a regional facility costs are to be distributed and assessed to all properties located within the defined assessment district (i.e., upstream watershed). Equalization of assessments will occur based on prior assessment districts to accommodate this distribution and a defendable determination of benefit provided.

LAND AND/OR EASEMENT ACQUISITION

It should be noted that land acquisition has not been incorporated into any of the opinions of probable cost. It is anticipated for the purposes of the master plan that in most, if not all cases, the lands required for these facilities will be located within Tier One of the Development Control Line. Therefore, they will consist of undevelopable properties and will be donated or dedicated for the purposes required under the Preferred Alternative.

LOCAL FACILITIES

Since starting the master planning process several other storm water facilities have been constructed. These include the Morgan Court Detention Facilities, constructed using an SID, and the Pinehurst Square Storm Water Facility constructed as part of a private commercial development. Both of these facilities fit very well into the objectives and goals established for this master plan.

THE FOLLOWING SHEETS PROVIDE A BREAKDOWN OF THE PROJECTED OPINION OF PROBABLE COST FOR THE PREFERRED ALTERNATIVE.

Tyler Coulee Watershed - Preferred Alternative
Engineer's Opinion of Probable Cost

Valley Drive Embankment

ITEM	UNIT	QUANTITY (Elevation 1610)	PRICE	TOTAL
Common Excavation (Spillway Borrow)	CY	1,900	$5.00	$9,500
Common Excavation (off-site fill)	CY	11,250	$9.00	$101,250
Topsoil Removal and Stockpile	CY	2,600	$4.00	$10,400
Triple 5' x 10' Concrete Box Culvert	LF	330	$2,000	$660,000
5' x 10' Concrete End Sections w/cutoffs	EA	2	$21,200	$42,400
End Section Drop Inlet 5' x 10' Box	EA	1	$6,300	$6,300
Pipe Bedding Flowable Fill	CY	140	$130	$18,200
72" RCP Riser Section	LS	1	$13,000	$13,000
48" RCP (Culvert Extension)	LF	80	$230	$18,400
36" RCP Inlet Control Pipe	LF	50	$160	$8,000
36" RCP FES	EA	1	$2,000	$2,000
Outfall Structure	LS	1	$83,000	$83,000
Erosion Control	LS	1	$4,000	$4,000
Seeding	SY	15,250	$3.50	$53,375
	Construction Costs			**$1,029,825**
	Contingencies		20%	$205,965
	Subtotal			**$1,235,790**
	Engineering		20%	$247,158
	City Legal & Admin.		10%	$123,579
	Total			**$1,606,527**

Tyler Parkway Embankment

ITEM	UNIT	QUANTITY (Elevation 1644)	PRICE	TOTAL
Common Excavation (off-site fill)	CY	49,100	$9.00	$441,900
Topsoil Removal and Stockpile	CY	6,800	$4.00	$27,200
6' x 6' Concrete Box Culvert	LF	320	$670	$214,400
6' x 6' Concrete End Section	EA	1	$13,000	$13,000
10-ft Riser Inlet (height = 20 ft)	EA	1	$37,500	$37,500
48" RCP	LF	60	$230	$13,800
48" RCP FES	EA	1	$3,000	$3,000
Pipe Bedding Flowable Fill	CY	60	$160	$9,600
Outfall Structure	LS	1	$95,000	$95,000
Erosion Control	LS	1	$4,000	$4,000
Seeding	SY	11,000	$3.50	$38,500
	Construction Costs			**$897,900**
	Contingencies		20%	$179,580
	Subtotal			**$1,077,480**
	Engineering		20%	$215,496
	City Legal & Admin.		10%	$107,748
	Total			**$1,400,724**

Valley Drive East Embankment

ITEM	UNIT	QUANTITY (Elevation 1699)	PRICE	TOTAL
Topsoil Removal and Stockpile	CY	1,200	$4.00	$4,800
36" RCP	LF	200	$160	$32,000
36" Inlet Drop Structure	LS	1	$5,500	$5,500
36" RCP 45^o Bends	EA	2	$3,450	$6,900
Pipe Bedding Flowable Fill	CY	200	$160	$32,000
Erosion Control	LS	1	$3,000	$3,000
Seeding	SY	2,000	$3.50	$7,000
	Construction Costs			**$91,200**
	Contingencies		20%	$18,240
	Subtotal			**$109,440**
	Engineering		20%	$21,888
	City Legal & Admin.		10%	$10,944
	Total			**$142,272**

Overland Road Embankment

ITEM	UNIT	QUANTITY (Elevation 16??)	PRICE	TOTAL
Topsoil Removal and Stockpile	CY	1,200	$4.00	$4,800
42" RCP Culvert	LF	200	$180	$36,000
42" Inlet Drop Structure	LS	1	$10,100	$10,100
42" RCP 45^o Bends	EA	2	$3,450	$6,900
Pipe Bedding Flowable Fill	CY	200	$160	$32,000
Erosion Control	LS	1	$3,000	$3,000
Seeding	SY	2,000	$3.50	$7,000
	Construction Costs			**$99,800**
	Contingencies		20%	$19,960
	Subtotal			**$119,760**
	Engineering		20%	$23,952
	City Legal & Admin.		10%	$11,976
	Total			**$155,688**

Eagle Crest Embankment

Elevation 16__ - To Be Determined

ITEM	UNIT	QUANTITY	PRICE	TOTAL
Common Excavation (off-site fill)	CY	22,200	$9.00	$199,800
Topsoil Removal and Stockpile	CY	3,000	$4.00	$12,000
36" RCP	LF	50	$160	$8,000
36" RCP FES	EA	1	$2,000	$2,000
72" RCP Drop Structure	LS	1	$13,000	$13,000
72" RCP	LF	200	$530	$106,000
72" FES	EA	1	$7,000	$7,000
Pipe Bedding	TON	50	$15	$750
Outfall Structure	LS	1	$63,500	$63,500
Erosion Control	LS	1	$3,000	$3,000
Seeding	SY	4,500	$3.50	$15,750
	Construction Costs			**$430,800**
	Contingencies		20%	$86,160
	Subtotal			**$516,960**
	Engineering		20%	$103,392
	City Legal & Admin.		10%	$51,696
	Total			**$672,048**

Golf Drive Corridor Improvements

Sewer Improvement District # 348 (1996) **Costs updated to 2006**

ITEM	UNIT	QUANTITY	PRICE	TOTAL
Storm Sewer Piping				
a) 72" RCP - CL IV	LF	24	$530	$12,720
c) 24" RCP - CL III	LF	50	$125	$6,250
d) 72" RCP Precast Energy Dissipater	EA	1	$19,250	$19,250
Earthwork				
a) Channel Excavation	CY	34,000	$6.00	$204,000
c) Topsoil Removal and Replacement	CY	4,900	$4.00	$19,600
Seeding				
a) Type I & II	AC	6	$1,500	$9,000
c) Maintenance of Grass	LS	1	$6,000	$6,000
Mulching	AC	6	$3,000	$18,000
Riprap	TON	5,600	$50	$280,000
Geotextile Under Riprap	SY	7,800	$5	$39,000
Clearing and Grubbing of Trees	AC	1	$6,000	$6,000
Miscellaneous Clearing	LS	1	$25,000	$25,000
Install Salvaged Riprap	SY	3,500	$30	$105,000
Erosion Control	LS	1	$4,000	$4,000
Landscaping	LS	1	$10,000	$10,000
	Construction Costs			**$763,820**
	Contingencies		10%	$76,382
	Subtotal			**$840,202**
	Engineering		15%	$126,030
	City Legal & Admin.		10%	$84,020
	Total			**$1,050,252**

Golf Drive Corridor Improvements

Sewer Improvement District # 348 (Revised - 48" RCP Storm Sewer Option)

ITEM	UNIT	QUANTITY	PRICE	TOTAL
Storm Sewer Piping				
48" RCP - CL III	LF	2870	$230	$660,100
24" RCP - CL III	LF	50	$125	$6,250
72" RCP Precast Box Outlet	EA	1	$19,250	$19,250
84" RCP Concrete Manhole	EA	5	$10,000	$50,000
Earthwork				
Granular Pipe Bedding	TON	1739	$15	$26,085
Topsoil Removal and Replacement	CY	2,100	$4.00	$8,400
Seeding				
Type I & II	AC	2.5	$1,500	$3,750
Maintenance of Grass	LS	1	$4,000	$4,000
Mulching	AC	2.5	$3,000	$7,500
Riprap	TON	100	$50	$5,000
Geotexile Under Riprap	SY	100	$5.00	$500
Clearing and Grubbing of Trees	AC	1	$5,000	$5,000
Miscellaneous Clearing	LS	1	$20,000	$20,000
Precast Energy Dissipater	EA	1	$25,500	$25,500
Erosion Control	LS	1	$3,000	$3,000
Landscaping	LS	1	$8,000	$8,000
	Construction Costs			**$852,335**
	Contingencies		10%	$85,234
	Subtotal			**$937,579**
	Engineering		15%	$140,636
	City Legal & Admin.		10%	$93,757
	Total			**$1,171,962**

Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX J

Stream Channel and Slope Protection Measures

APPENDIX J
STREAM CHANNEL AND SLOPE PROTECTION MEASURES
TYLER COULEE WATERSHED

INTRODUCTION

One objective for the Tyler Coulee Storm Water Master Plan was to define those measures necessary to protect lands located along all storm water conveyance corridors. Establishing a Development Control Line (DCL) was the first step, which was to be followed by a recommendation for a design procedure to address the protection of sensitive areas. These include those along the Tyler Coulee stream channel, the steeper tributary channels, and on the adjacent slopes along and on which runoff may be concentrated and/or discharged from new development. This appendix defines the technical issues and provides a guideline from which engineering evaluations and designs can be completed to preserve and protect these corridors.

TYLER COULEE DRAINAGE BASIN

The Tyler Coulee drainage basin is located on the east side of the Missouri River Breaks. The upper reaches of this basin are characterized by level to gently rolling prairie in the undisturbed state that contributes undifferentiated surface runoff to the defined tributary channels of Tyler Coulee. As one proceeds downstream along the coulee and drainage basin, drainage channels become more defined and grades are steeper, reaching 15% to 30% in the lower reaches. The main stream channel is also rather steep ranging from 3% in the upper portion of the basin to 1.5% in the south. The main stream channel conveys runoff from the developed and prairie areas southwest to the Missouri River.

SOIL CHARACTERISTICS

Soil types in the drainage basin were obtained from the Burleigh County Soil Survey. The Soil Survey characterizes soil types in the Tyler Coulee Basin with a three (3) letter code. The first two letters designate the soil type based upon standard classification nomenclature and the third letter denotes the average slope of the soil type. The third letter codes are presented in the table below:

Letter Description	Gradient in Percent	Text Description
A	0 to 3	Gently Sloping
B	3 to 6	Undulating
C	6 to 9	Rolling
D	9 to 15	Hilly
E	15 to 30	Steep

The Burleigh County Soil Survey classifies grades in the upper portions of the drainage basin as relatively flat to gently sloping with 0% to 3% grades. As one proceeds downstream from the upper reaches to lower reaches of the drainage basin, land and channel slopes continue to steepen. The majority of the tributaries consist of Werner complex loam soils (WcF) having slopes ranging from 15% to 30%.

The drainage basin soil classifications and characteristics are briefly discussed below:

AgB: Arnegard and Grassna silt loams gently sloping with 4 to 6% slopes. This soil has moderate surface runoff and moderate erosion hazard. The main management concerns include controlling wind and water erosion. This soil is classified A6 or CL with 90 to 95% passing the No. 40 sieve.

MnA: Mandan silt loam gently sloping with 0 to 3% slopes. This soil has moderate surface runoff. The main management concerns include controlling wind and water erosion. This soil is classified as ML and A4 with 85 to 90% passing the No. 4 sieve.

MoB: Mandan silt loams undulating with 3 to 6% slopes. The main management concerns with this soil include controlling wind blowing and water erosion. This soil is classified as ML and A4 with 85 to 90% passing the No. 4 sieve.

MoC: Mandan Linton silt loams rolling with 6 to 9% slopes. Surface runoff is medium. This soil is moderately affected by wind erosion and highly susceptible to water erosion. This soil is classified as ML and A4 with 85 to 90% passing the No. 4 sieve.

SnC: Sen Series silt loam, hilly with 9 to 12% slopes. This series is very susceptible to water erosion. Management concerns with this soil include controlling moisture content and water erosion. This soil is classified ML or CL, A4 or A6, with about 95% passing the No. 4 sieve.

TnB: Temvik series silt loam with undulating 3 to 6% slopes. This soil is moderately susceptible to wind and water erosion. Management concerns with this soil include controlling moisture content and water erosion. These soils are classified ML or CL or A4 or A7 with 85 to 90% passing the No. 4 sieve.

TnC: Temvik series silt loam rolling with 6 to 9% slopes. This soil is moderately susceptible to wind erosion and highly susceptible to water erosion. Management concerns with this soil include controlling erosion and conserving moisture. These soils are classified ML or CL or A4 or A7 with 85 to 90% passing the No. 4 sieve.

WcF: Werner complex loam, steep with grades from 15 to 30%. This soil is very susceptible to water erosion. Management concerns for this soil are conserving moisture and preventing water erosion. These soils are classed ML or CL, A4 or A6 and have 75 to 90% passing the No. 40 sieve

WeE: Werner, Sen, Morton complex, hilly with grades from 9 to 15%. This soil is highly susceptible to water erosion. The low water capacity and high susceptibility to water erosion are the main management concerns.

With the exception of Arnegard soil which is classified as CL, the above soils are all characterized as ML or CL with the ML classification predominant. The ML classification generally refers to a fine grained silty to silty clay loam material that has limited cohesiveness (low clay content or plasticity). The lack of cohesiveness coupled with a small grain size results in a soil that is easily eroded by water action. This is also corroborated by the Soil Survey's listing of wind and water erosion as major soil management concerns.

Limiting or eliminating water and wind related erosion is best obtained by maintaining a dense vegetative cover on the soil and limiting the volume and flow velocity of water over the soil surface.

VEGETATION COVER

Large tracts of the eastern portion of the drainage basin have been developed into residential housing with associated paved streets, curb and gutter and above and below ground storm drainage systems that collect and convey runoff to Tyler Coulee via tributary channels. Additional lands are scheduled for development into residential properties. The western portion of the upper drainage basin is still undeveloped and under cultivation. The central portion of the drainage basin contains the primary and tributary channels, which have more relief and remain mostly undeveloped.

Development generates more runoff in a shorter time frame than similarly sized undeveloped areas for the following reasons:

1. The time of concentration is lower in developed areas due to decreases in the length of overland flow and more defined flow channels. More clearly defined channels include man made drainage swales, street gutters or ditches, and storm drainage conduit. A shorter time of concentration produces higher peak flows because it takes less time for runoff from the most distant point in the design reach to reach the design point. Residential lots are generally graded with the intent of removing storm runoff as quickly as possible to preclude standing water in the yards.

2. The quantity of runoff is increased due to a decrease in the retardance of the drainage area. This is caused in part by the increase in impermeable areas associated with structure footprints, pavement, sidewalks, driveways, etc. Residential yards are usually graded to drain away from structures and to not have low areas which will retain precipitation or allow infiltration. Residential lawns often have less thatch and are maintained in a much shorter condition than wild native grasses. An irrigated lawn typically has higher ambient moistures, due to frequent watering, compared to natural conditions and thus allows less infiltration than unmaintained grassed areas.

3. The overland flow distances are generally shorter in the developed condition. Sheet flow runoff travels much slower in natural conditions than runoff collected and concentrated in channels whether earthen or paved. Longer flow times allow more time for infiltration and retention of a greater portion of the runoff.

As noted the soils in the Tyler Coulee drainage basin are predominantly fine grained, non-cohesive soils and are very prone to wind and water erosion. Existing development has, in some cases, been required to provide storm water detention and other measures to limit peak discharges to more sustainable levels. The net effect of existing and future development in the basin is continued and accelerated erosion of the downstream basin drainage channels. Even under controlled flow conditions the extended duration of flows resulting from development will have an impact on channel stability.

Recommended measures to minimize and reduce existing and expected future soil erosion include but are not limited to:

- Require new development to consider the overall impact of the increased runoff on the downstream drainage basin as a whole. Therefore, the responsibility for erosion control does not end at the downstream end of their development. The storm water management plan and permit process is available for use to control future development activities.

- Require new development to provide suitable detention storage and/or hydraulic energy dissipators to maintain a maximum flow velocity of between 2 and 3 feet per second in natural channels.

- Require the use of natural topography, e.g., existing channels and construction of detention storage structures, for temporary storage to reduce or limited release rates rather than constructing artificial channels and storage basins in the upper portions of the basin. Artificial channels and storage facilities should only be used with the City's permission.

- Utilizing detention storage will typically lower peak flows and velocity at the expense of extending the duration of discharge. The use of on site retardance techniques and/or underground detention can also be used to increase runoff infiltration and lessen runoff quantities and potentially peak flows. The use of infiltration systems, however presents issues related to ground water impacts that need to be considered.

- The *Calculation of Allowable Flow Channel Velocity* information following this section may be used to determine the allowable flow velocity and depth of flow parameters for the affected tributary and downstream channels. This is necessary to ensure an acceptable level of channel stability and erosion damage prevention.

- Establish specific criteria for design that present the maximum flow parameters such as depth, velocity and duration of discharge for the natural channel condition. These base criteria should also be determined for natural channels that may be modified to improve their flow conveyance characteristics for both constructed and maturely vegetated channels.

- Recommend the degree and type of channel armoring required to convey the proposed design flow without excessive erosion or with an acceptable level of risk for erosion in the affected tributary. Some forms of channel armor include grass, concrete, rip rap, and permanent erosion control fabric. When seeding, the mixture should contain native grasses with quick growing annuals as temporary cover while permanent growth is established.

- If the channel is armored, the impact on the downstream channel needs to be considered. The velocity of flow in downstream channels must be limited to less than that which would damage and cause erosive conditions in the channel.

- Conveying part or all of a 100 year storm event in an underground storm sewer system is another potential alternative. The storm sewer may be sized for the design 100 year flows or for a smaller flow capacity if used in concert with upstream detention and limited overland or surface flows.

- The downstream segments of the drainage system must be protected from damage by upstream contributors, especially if flows are conveyed in armored channels, storm sewer pipe or a combination of the two. Some form of detention storage, energy dissipation and/or other means of conveyance must be provided to prevent erosion damage.

- Any disturbed areas should be repaired using soil matting and applicable seeding. It is strongly encouraged to utilize a native seed mixture that matches, to the extent practical, the current grasses within and along the green space area.

- Under no circumstances shall overland flow velocities, or those within storm sewers, be allowed to be supercritical.

CITY STORMWATER DESIGN STANDARDS MANUAL

The City's Stormwater Design Manual (Manual) is to be used by developers and others who will be changing the natural drainage conditions within the City of Bismarck and surrounding areas. Chapter 7 addresses the designing open channels and related appurtenances. Open channels, whether natural or artificial, are required to be capable of conveying storm runoff without erosion of the channel structure, which is to be verified by a hydraulic analysis. The information at the end of this section presents analytical methods for determining the safe flow depth and velocity.

The City's preferred method for conveying channelized storm runoff is to use a grassed channel. Flow velocity and depth are limiting factors in open channel flow design as the depth of flow and channel slope are integral in determining the projected velocity in a particular open channel. These velocities must be limited so as not to cause erosion of the channel prism. Alternative channel linings such as erosion control matting, rock riprap and energy dissipators such as rock riprapped drop structures may be utilized with the City's permission via the storm water management plan and permit process.

The requirement for erosion and sediment control does not end at the edge of the development or point of discharge. Developers are generally responsible for the installation and initial maintenance of any new storm runoff control and conveyance structures. Thus, they must analyze the potential affect on downstream portions of the receiving stream and determine if any adverse impacts may occur due to increased runoff and flows generated by the proposed development.

One method that would effectively bind the developer with responsibility for initial operation and maintenance of the storm runoff control and conveyance structures is to require a performance bond be obtained by the Developer, payable to the City. The City would have the right to utilize the bond funds to maintain and repair the developer's storm runoff control and conveyance structures in the event the Developer defaults on his responsibilities. It is anticipated the bond life would probably be between three and five years, with the option to extend for another defined period should deficiencies be noted during the initial period.

Restrict over lot grading to no steeper than 4 horizontal to 1 vertical (4:1) adjacent to steep slopes near conveyance zones. To provide this, the Developers will need to terrace and use retaining walls. The purpose is to the minimize amount and velocity of sheet flow leaving the yards and flowing down the erosion sensitive channel banks.

CALCULATION OF ALLOWABLE CHANNEL VELOCITY

PROBLEM DESCRIPTION

Natural waterways receive runoff from the storm water system (i.e., streets, pipes, open channels, urban development, fields and detention/retention areas) throughout the Tyler Coulee watershed. These natural waterways are generally the primary means of storm water conveyance from the developing, upper portion of the watershed, to the lower portion of the watershed, prior to discharging into the Missouri River. The use of natural drainage channels to convey runoff presents unique design challenges. Runoff needs to be conveyed, while reasonably ensuring that the stream channel remains "stable."

Several engineering methods can be used to evaluate channel stability (see *Technical Release 25, Design of Open Channels, Natural Resources Conservation Service*). The primary differences between methods are whether the channel boundary is assumed to be rigid or mobile, the type of material (particle size) being transported, and whether the bed and bank materials are cohesive and/or vegetated.

A practical method to review development proposals and channel modifications is needed by the City to evaluate the potential for coulee channel stability problems. The information presented in the following sections establishes an "approximate" allowable discharge for stream channels as an initial assessment of "channel stability".

CHANNEL STABILITY DEFINED

Two general schools of thought are used to define channel stability:

- A channel is stable up to the point when the material comprising the bed and bank (i.e., sand, gravel, clay, and cobble) becomes mobile (begins moving downstream). This school of thought essentially treats the channel boundary as rigid (the <u>permissible velocity</u> and <u>tractive force</u> methods):

- A channel is stable when the amount of sediment entering and leaving a stream reach is equal and the channel has reached a dynamic equilibrium (i.e., sediment balance method).

The allowable velocity and tractive force methods are based upon the first school of thought. The latter school of thought (i.e., the sediment balance method) generally requires more rigorous engineering analysis. In reality, methods associated with both schools of thought may need to be applied, when more rigorous analysis[1] is needed.

Because of the ease of application and the need for less detailed field data, we recommend use of the allowable velocity and/or tractive force methods to initially assess the about channel stability, prior to requiring the application of the sediment balance method. Engineering judgment must be used when applying these methods and it should be realized that some movement of channel material should be expected.

ALLOWABLE VELOCITY APPROACH

The allowable velocity approach[2] is based upon the testing of the erosive resistance of earthen channels. The channels tested to develop this methodology were generally well seasoned, with low gradients and flow depths less than thee feet. It may be difficult to apply this in locations with steep slopes, meaning other conveyance methods, namely storm sewers or lined channels may be required. General information is required regarding the amount of fine material being carried in suspension. The approach generally consists of the following:

- Determining the hydrology (i.e., rate and amount of runoff) and hydraulics (water surface elevation and velocity) of the system. This includes estimating the peak flow rates for the critical duration event[3], as well as stage-discharge-velocity relationships for the waterway being evaluated.

- Determine the properties of the earth materials forming the banks and bed of the waterway being investigated.

- Determine the sediment yield to, or sediment concentration within, the waterway being investigated. Existing monitoring data can be used to establish the concentration.

- Compare the design velocities for the 2-year and 10-year events of critical duration, with the allowable velocities from charts, for the material forming the channel boundary.

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[1] The most recent version of the U.S. Army Corps of Engineer's HEC-RAS contains many of the channel stability assessment methods described by Technical Release No. 25. The use of these methods is encouraged as a "normal" part of project development, to determine the shear stress and average velocity as a function of discharge.

[2] The information presented is directly from Technical Release No. 25, Design of Open Channels, Natural Resource Conservation Service.

[3] The critical duration event is the storm duration equal to the time of concentration, which leads to the maximum peak discharge.

- Peak flow must be reduced, if the allowable velocity is exceeded.

- Additional analysis should be completed using less frequent return period events (e.g., 100-year) and if near the allowable velocity, flows further reduced (at the discretion of the City Engineer).

The channel is considered stable if the average channel velocity is less than the allowable velocity. The allowable velocity is determined using a series of nomographs and channel characteristics. Despite the empirical nature of the approach[4], the allowable velocity method continues to be used to design stable channels throughout the United States. One of the primary disadvantages of this method is that the allowable velocity is a function of the channel geometry, rather than the properties of the materials comprising the channel bed and bank.

TRACTIVE FORCE APPROACH

Water flowing in a channel creates a (hydrodynamic) force known as the "tractive force." The basis for this method is that the tractive force induced by the flowing water should not exceed a permissible or critical tractive force (i.e., the shear stress) of the lining material[5]. When the flow in a channel is uniform, the tractive force is equal to the effective component of the gravitational force acting on the body of the water, parallel to the channel bottom. Water flowing in a channel causes shears stresses, which are not uniform across a channel. Bends in the channel cause higher stress on the inside and outside bends. Shear stress is generally greater in the deeper main portion of the channel.

The advantage of this approach is that the criteria for channel "failure" (i.e., exceeding the critical shear stress) is represented by a single value, dependent upon the characteristics of the channel materials. The critical shear stress value is applicable over a wide range of channel slopes and geometries.

Applying the tractive force method to determine an "allowable discharge" consists of:

- Establish the design discharge for the channel.
- Determine the permissible shear stress based on the channel materials.
- Compute the allowable depth from the permissible shear stress.
- Based upon the channel geometry, compute the discharge associated with the permissible shear stress, using Manning's equation or some other appropriate method.
- Compare the allowable discharge to the design discharge.

[4] The method is considered empirical because it fails to explicitly model detachment and erosion processes.
[5] See *Design of Roadside Channels and Flexible Linings*, Hydraulic Engineering Circular No. 15, Federal Highway Administration.

Details and examples of both the allowable velocity and tractive force approaches can be found in *Design of Roadside Channels with Flexible Linings*, Hydraulic Engineering Circular No. 15, Federal Highway Administration (Publication FHWA-IP-87-7; April 1988). Examples of the two methods are reproduced here, for illustrative purposes.

METHOD LIMITATIONS

The allowable velocity and tractive force approaches are applicable to vegetated and unvegetated channels with rigid boundaries. This means the stream channel remains essentially unchanged through the flow range of interest. Additional steps in the calculation process need to be applied for channel slopes exceeding 10% and bank or side slopes exceeding 3:1.

DESIGN EVENTS

These methods should be applied to the peak discharge for the 2-year (or bank full/dominant discharge if known from field observations) and 10-year critical duration storm events. The analysis should include consideration of the amount of time the allowable velocity is exceeded (which may require hydrograph routing be completed). Exceeding the allowable velocity or critical shear stress by some nominal amount for a short duration may be acceptable, but no general rule of thumb is available. Engineering judgment must be applied. In all cases a testing of the 100-year event flows is required so as not to exceed the City's design standards.

APPLICATION TO TYLER COULEE

The allowable velocity and tractive force approaches are the recommended method for ***initial*** use within the Tyler Coulee Watershed (and natural waterways and open channels in other watersheds as well), to assess natural waterway stability. The application of these methods is a reasonable starting point to identify whether there is a potential for movement of the channel substrate and instability. More detailed engineering analysis should be applied if the allowable velocity or tractive force approaches indicate that particle movement (i.e., erosion) may occur. This detailed analysis should include application of the HEC-RAS model (or some similar method) to the specific area or channel of concern and evaluating the available sediment supply and transport through the channel reach.

Most engineers readily relate to average velocity, because it is commonly computed during design of the storm water management system. Average velocities of 2 to 3 feet per second are common in natural channels and likely of little concern. But, as velocity increases, so does the erosive force of water, thus increasing the risk for erosion and reduced channel stability.

Typically the relationship between discharge (x-axis), shear stress (left y-axis) and average velocity (right y-axis) are graphed for comparative purposes. The critical shear stress for various material types is also shown on such graphs. Assuming the critical shear stress is ~1 lb/ft^2, these graphs would then illustrate the range for the maximum allowable discharges within a designated channel area.

One issue that commonly requires resolution is the selection of the specific design discharge. It is recommended using both the 2-year and 10-year critical duration events for evaluating stability (i.e., evaluating the critical shear stress). Average velocity is generally 3 to 5 feet per second. These velocities are relatively "low" but should be evaluated relative to the allowable velocity.

RECOMMENDATIONS:

This memorandum illustrates the use of two methods to establish the allowable discharge through natural channels, as a first-cut screening analysis. The recommendation to use the allowable velocity and tractive force approach is based upon the general philosophy that the method needs to:

- Be applied by developers and others including City staff;
- Be reviewed by City staff;
- Provide consistent results; and
- Determine whether additional or more detailed analysis is necessary.

The application of this approach requires storm water analyses (i.e., change in flow rates) be completed to the point where storm water runoff enters the natural waterway[6]. In some cases, this may be a considerable distance downstream from the project locations. This is a departure from the current approach, which is completed to the project boundary limits.

It is anticipated that the City will request developers or project proponents to use and apply both methods and present the data in their storm water management plan when a plat is submitted for review. Site-specific information at the most upstream section of the nearest natural waterway should be used when applying these methods. This information includes channel geometry and an analysis of the material comprising the substrate. Ideally, the method would be "formalized" and incorporated into a Storm Water Design Manual used during the review of development applications. It is also anticipated that some adjustment to the methods may be needed, based upon information and knowledge gained as it is applied to projects around the community.

In addition to the technical design measures found herein the last pages of this appendix contain notable Best Management Practices (BMP's) presented during the Tyler Coulee Public Informational Meetings that should be considered part of the development process.

[6] The City and County may also want / require analysis at additional locations, especially those with known stability problems.

EXAMPLE CALCULATIONS – ALLOWABLE VELOCITY

Allowable Velocity Approach Example: The following example is taken from *Design of Open Channels, Technical Release No. 25, Natural Resource Conservation Service.* The example is presented to illustrate use of the method.

Example 6-1

Given: A channel is to be constructed to convey the flow from a 2 percent chance flood through an intensively cultivated area. The hydraulics of the system indicate that a trapezoidal channel with 2:1 side slopes and a 40 foot bottom width will carry the design flow at a depth of 8.7 feet and a velocity of 5.45 fps. Soil investigations reveal that the channel will be excavated in a moderately rounded clean sandy gravel with a D_{75} size of 2.25 inches. Sampling of soils in the drainage area and estimate of erosion and sediment yield indicate that on an average annual basis approximately 1000 tons of sediment finer than 1.0 mm. and 20 tons of material coarser than 1.0 mm are available for transport in channel. The amount of abrasion resulting from the transporting of this small amount of sediment coarser than 1.0 mm. is considered insignificant. Sediment transport computations indicate all of the sediment supplied to the channel will be transported through the reach. The sediment transport and hydrologic evaluations indicate the design flow will transport the available sediment at a concentration of about 500 ppm. The channel is straight except for one curve with a radius of 600 feet.

Determine:

1. The allowable velocity, V_a
2. The stability of the reach.

Solution: Determine basic velocity from Figure 6-2, sediment free curve because sediment concentration of 500 ppm is less than 1,000 ppm.

$V_b = 6.7$ fps

Depth correction factor, D = 1.22 (from Figure 6-2)

Bank slope correction, B = 0.72 (from Figure 6-2)

Alignment correction A

$$\frac{\text{curve radius}}{\text{water surface width}} = \frac{600}{74.8} = 8.02$$

A = 0.89 (from Figure 6-2)

Density correction, C_e, does not apply

Frequency correction, F, does not apply

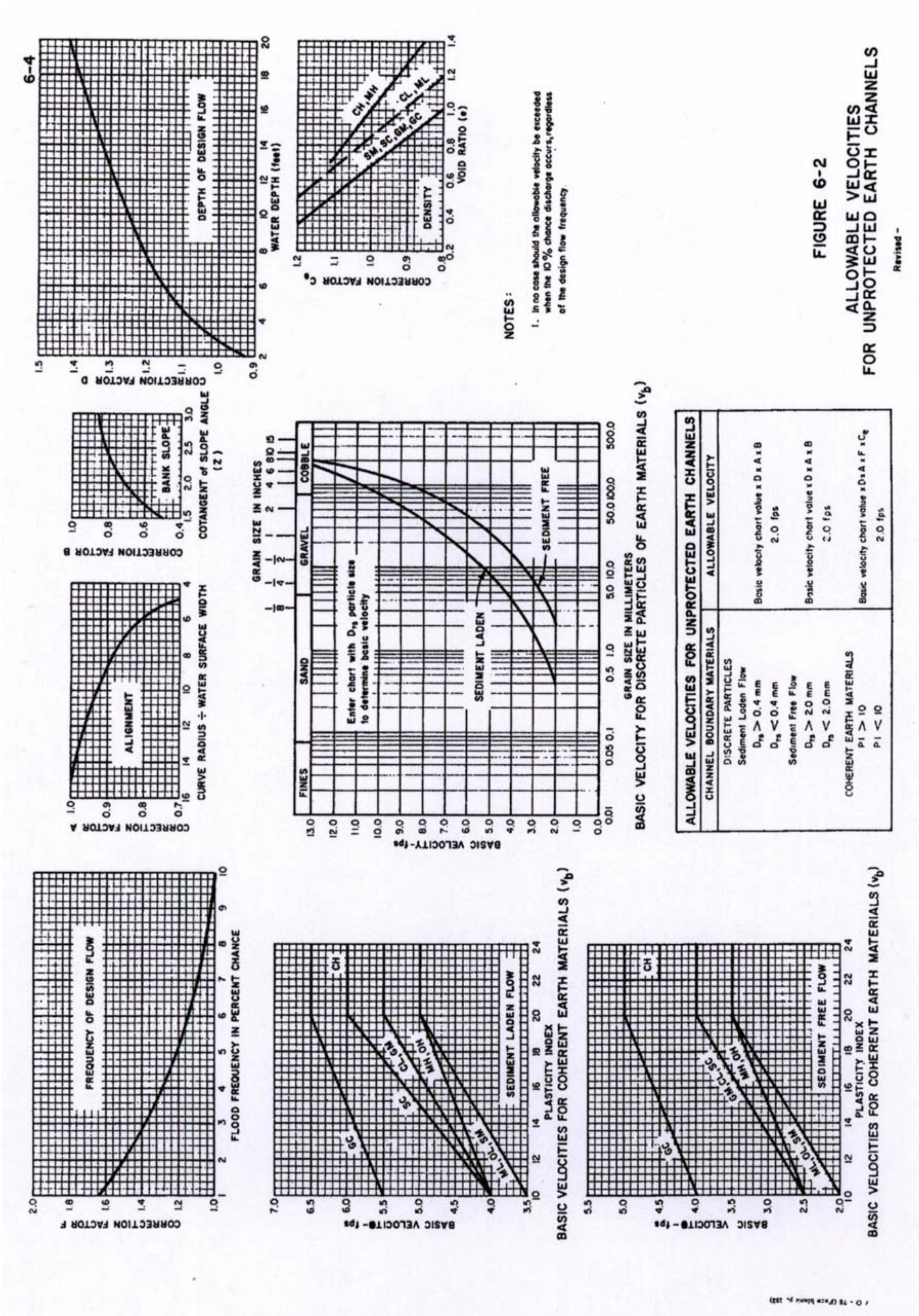
$V_a = V_bDB = (6.7)(1.22)(0.72)$ straight reaches

$= 5.88$ fps

$V_a = V_bDBA = (6.7)(1.22)(0.72)(0.89)$ curved reach

$= 5.24$ fps

The proposed design velocity of 5.45 fps is less than $V_a = 5.88$ fps in the straight reaches but greater than $V_a = 5.24$ fps in the curved reaches. Either the channel alignment or geometry needs to be altered or the curve needs structural protection.



6-4
FREQUENCY OF DESIGN FLOW
CORRECTION FACTOR F
FLOOD FREQUENCY IN PERCENT CHANCE
ALIGNMENT
CORRECTION FACTOR A
CURVE RADIUS ÷ WATER SURFACE WIDTH
BANK SLOPE
CORRECTION FACTOR B
COTANGENT of SLOPE ANGLE (Z)
DEPTH OF DESIGN FLOW
CORRECTION FACTOR D
WATER DEPTH (feet)
SEDIMENT LADEN FLOW
BASIC VELOCITY - fps
PLASTICITY INDEX
BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)
GRAIN SIZE IN INCHES
FINES
SAND
GRAVEL
COBBLE
Enter chart with D_{75} particle size to determine basic velocity
SEDIMENT LADEN
SEDIMENT FREE
GRAIN SIZE IN MILLIMETERS
BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS (v_b)
DENSITY
CORRECTION FACTOR C_e
VOID RATIO (e)
CH, MH
CL, ML
SM, SC, GM, GC
SEDIMENT FREE FLOW
BASIC VELOCITIES FOR COHERENT EARTH MATERIALS (v_b)
ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS
CHANNEL BOUNDARY MATERIALS
ALLOWABLE VELOCITY
DISCRETE PARTICLES
Sediment Laden Flow
$D_{75} > 0.4$ mm
$D_{75} < 0.4$ mm
Basic velocity chart value x D x A x B
2.0 fps
Sediment Free Flow
$D_{75} > 2.0$ mm
$D_{75} < 2.0$ mm
Basic velocity chart value x D x A x B
2.0 fps
COHERENT EARTH MATERIALS
PI > 10
PI < 10
Basic velocity chart value x D x A x F x C_e
2.0 fps
NOTES:
1. In no case should the allowable velocity be exceeded when the 10% chance discharge occurs, regardless of the design flow frequency.
FIGURE 6-2
ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS
Revised -

EXAMPLE CALCULATION – TRACTIVE FORCE

Tractive Force Approach Example: The following example is taken from *Design of Open Channels, Technical Release No. 25, Natural Resource Conservation Service*. The example is presented to illustrate use of the method.

Find: Maximum allowable discharge.

Solution: (1) From table 1, a good stand of Kentucky bluegrass is classified as retardance C. From table 2 the permissible shear stress,

$\tau_p = 1.00 \text{ lb/ft}^2$

Determine the allowable depth from equation 5, given $\tau_d = \tau_p$,

$$d = \tau_p / \gamma S$$

$$= \frac{1.00}{62.4 \times 0.010}$$

$$= 1.6 \text{ ft}$$

Note that the allowable depth is less than the depth of the ditch.

(2) Determine the flow area and hydraulic radius from chart 4, given $d/B = 0.40$,

$A/Bd = 2.6$
$A = 16.6$
$R/D = 0.61$
$R = 0.98$

(3) From chart 7: $n = 0.072$.

(4) Solving the Manning's equation with continuity (equation 9),

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

$$= \frac{1.49}{0.072} \times 16.6 \times 0.98^{2/3} \times 0.01^{1/2}$$

$$= 33.9 \text{ cfs}$$

Example 8:

Determine the need for a granular filter blanket.

Given: Riprap Gradation

$D_{85} = 1.3$ ft
$D_{50} = 0.66$ ft
$D_{15} = 0.33$ ft

Base Soil Gradation

$D_{85} = 1.5$ mm $= 0.0049$ ft
$D_{50} = 0.5$ mm $= 0.0016$ ft
$D_{15} = 0.167$ mm $= 0.00055$ ft

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Table 1. Classification of Vegetal Covers as to Degree of Retardance. (4)

Retardance Class	Cover	Condition
A	Weeping lovegrass	Excellent stand, tall (average 30") (76 cm)
	Yellow bluestem Ischaemum	Excellent stand, tall (average 36") (91 cm)
B	Kudzu	Very dense growth, uncut
	Bermuda grass	Good stand, tall (average 12") (30 cm)
	Native grass mixture (little bluestem, bluestem, blue gamma, and other long and short midwest grasses).........	Good stand, unmowed
	Weeping lovegrass	Good stand, tall (average 24") (61 cm)
	Lespedeza sericea	Good stand, not woody, tall (average 19") (48 cm)
	Alfalfa	Good stand, uncut (average 11") (28 cm)
	Weeping lovegrass	Good stand, unmowed (average 13") (33 cm)
	Kudzu	Dense growth, uncut
	Blue gamma	Good stand, uncut (average 13") (28 cm)
C	Crabgrass	Fair stand, uncut (10 to 48") (25 to 120 cm)
	Bermuda grass	Good stand, mowed (average 6") (15 cm)
	Common lespedeza	Good stand, uncut (average 11") (28 cm)
	Grass-legume mixture--summer (orchard grass, redtop, Italian ryegrass, and common lespedeza)....	Good stand, uncut (6 to 8 inches) (15 to 20 cm)
	Centipedegrass.............	Very dense cover (average 6 inches) (15 cm)
	Kentucky bluegrass.........	Good stand, headed (6 to 12 inches (15 to 30 cm)
D	Bermuda grass..............	Good stand, cut to 2.5-inch height (6 cm)
	Common lespedeza	Excellent stand, uncut (average 4.5") (11 cm)
	Buffalo grass	Good stand, uncut (3 to 6 inches (8 to 15 cm)
	Grass-legume mixture--fall, spring (orchard grass, redtop, Italian ryegrass, and common lespedeza)...............	Good stand, uncut (4 to 5 inches) (10 to 13 cm)
	Lespedeza sericea	After cutting to 2-inch height (5 cm) Very good stand before cutting
E	Bermuda grass	Good stand, cut to 1.5 inch height (4 cm)
	Bermuda grass	Burned stubble

NOTE: Covers classified have been tested in experimental channels. Covers were green and generally uniform.

Table 2. Permissible Shear Stresses for Lining Materials.

Lining Category	Lining Type	Permissible Unit Shear Stress[1] (lb/ft^2)	(Kg/m^2)
Temporary*	Woven Paper Net	0.15	0.73
	Jute Net	0.45	2.20
	Fiberglass Roving:		
	Single	0.60	2.93
	Double	0.85	4.15
	Straw with Net	1.45	7.08
	Curled Wood Mat	1.55	7.57
	Synthetic Mat	2.00	9.76
Vegetative	Class A	3.70	18.06
	Class B	2.10	10.25
	Class C	1.00	4.88
	Class D	0.60	2.93
	Class E	0.35	1.71
Gravel Riprap	1-inch	0.33	1.61
	2-inch	0.67	3.22
Rock Riprap	6-inch	2.00	9.76
	12-inch	4.00	19.52
Bare Soil	Non-cohesive	See Chart 1	
	Cohesive	See Chart 2	

[1] Based on data in (5, 8, 13, 14, 15).

*Some "temporary" linings become permanent when buried.

Chart 1

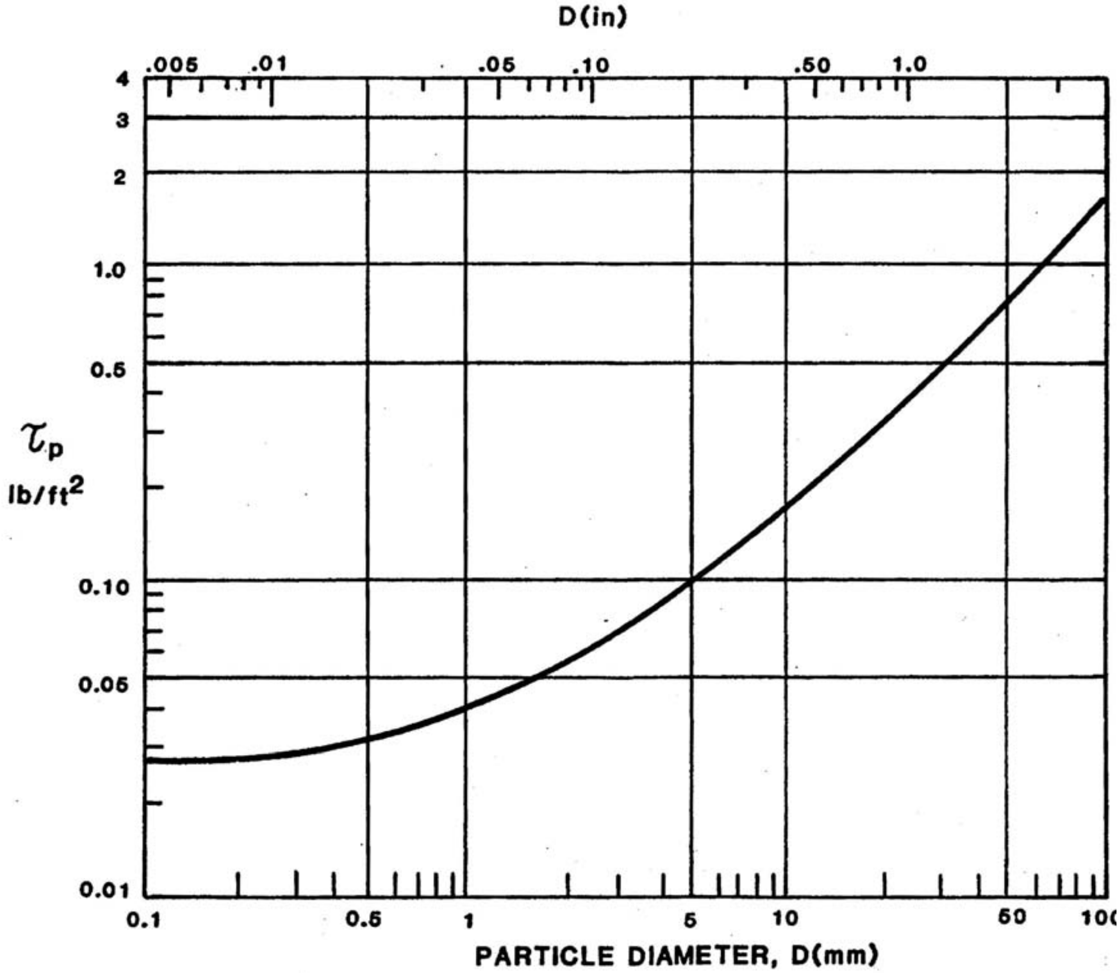


Chart 1. Permissible shear stress for non-cohesive soils. (after 15)

38

Chart 2

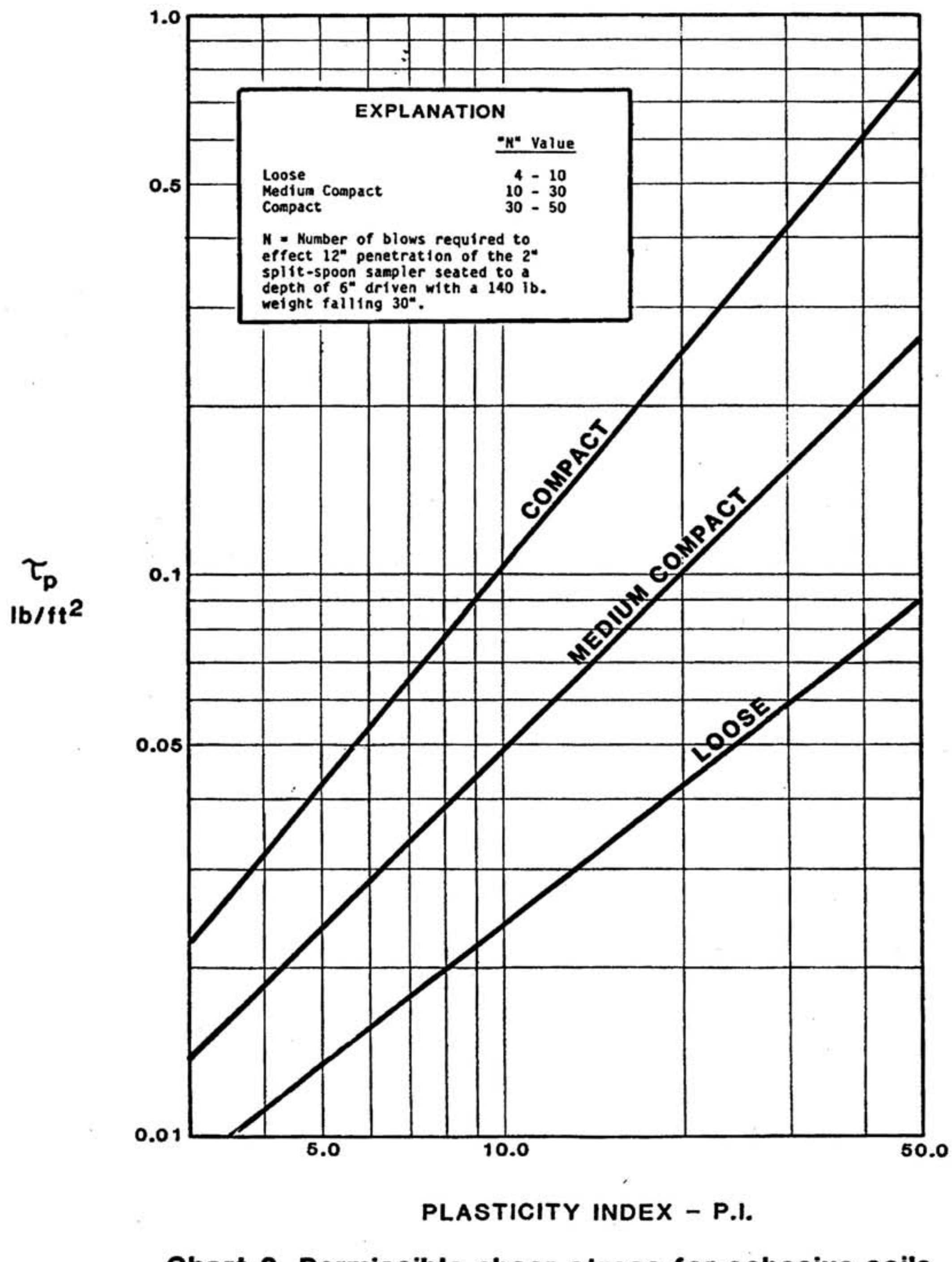
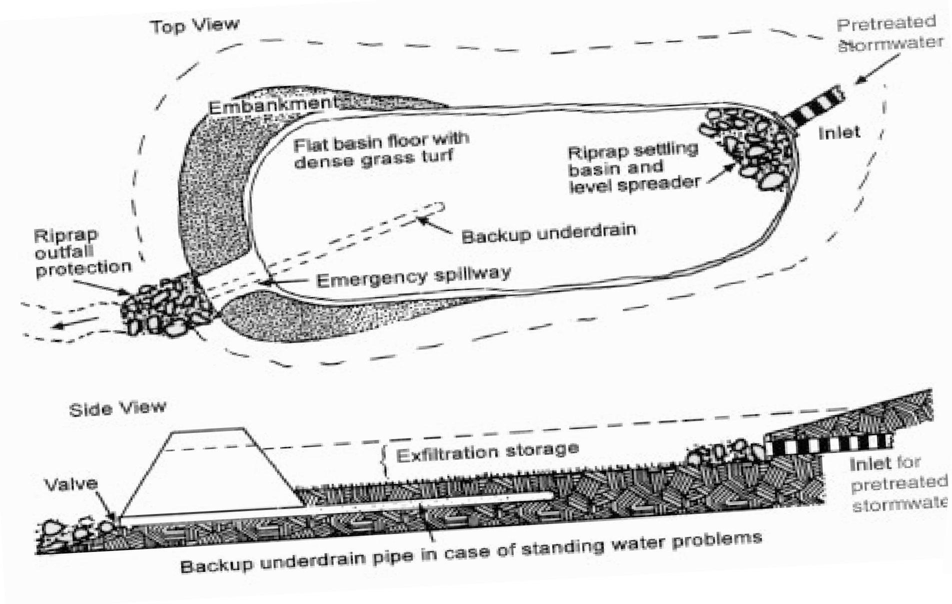
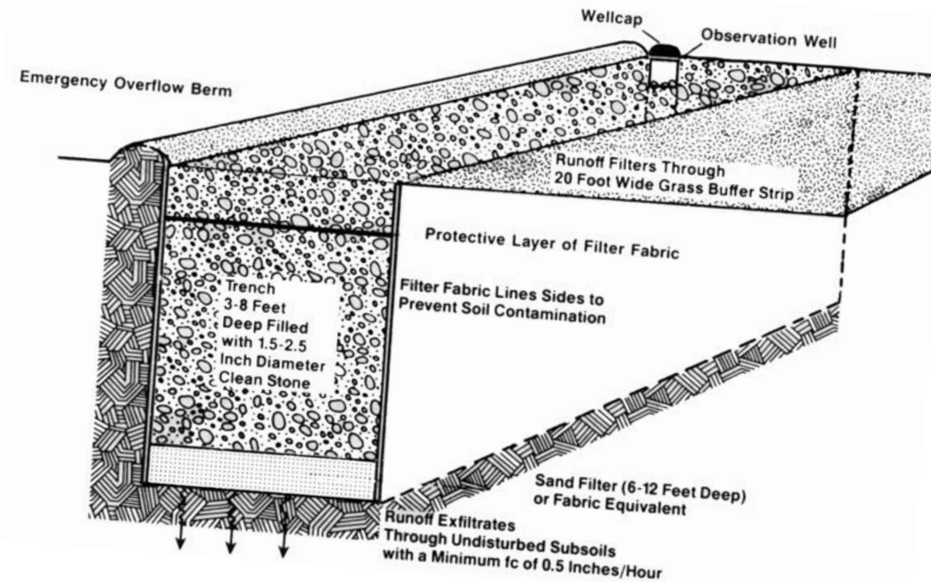


Chart 2. Permissible shear stress for cohesive soils. (after 16)

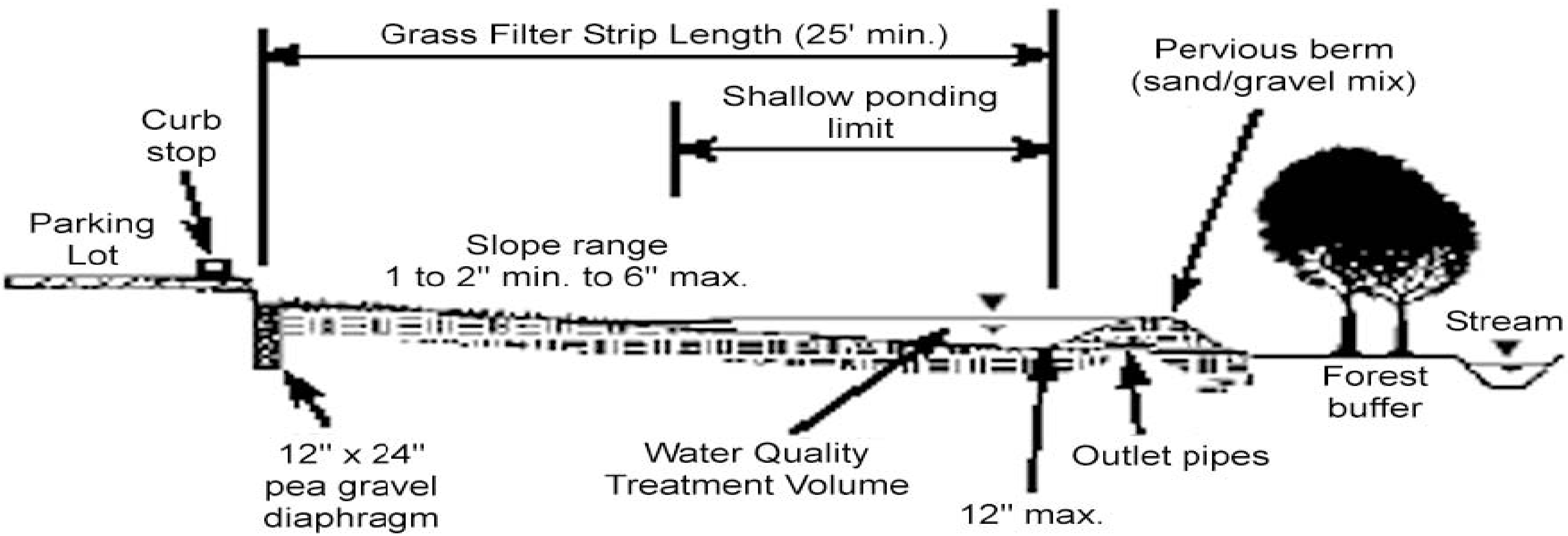
39



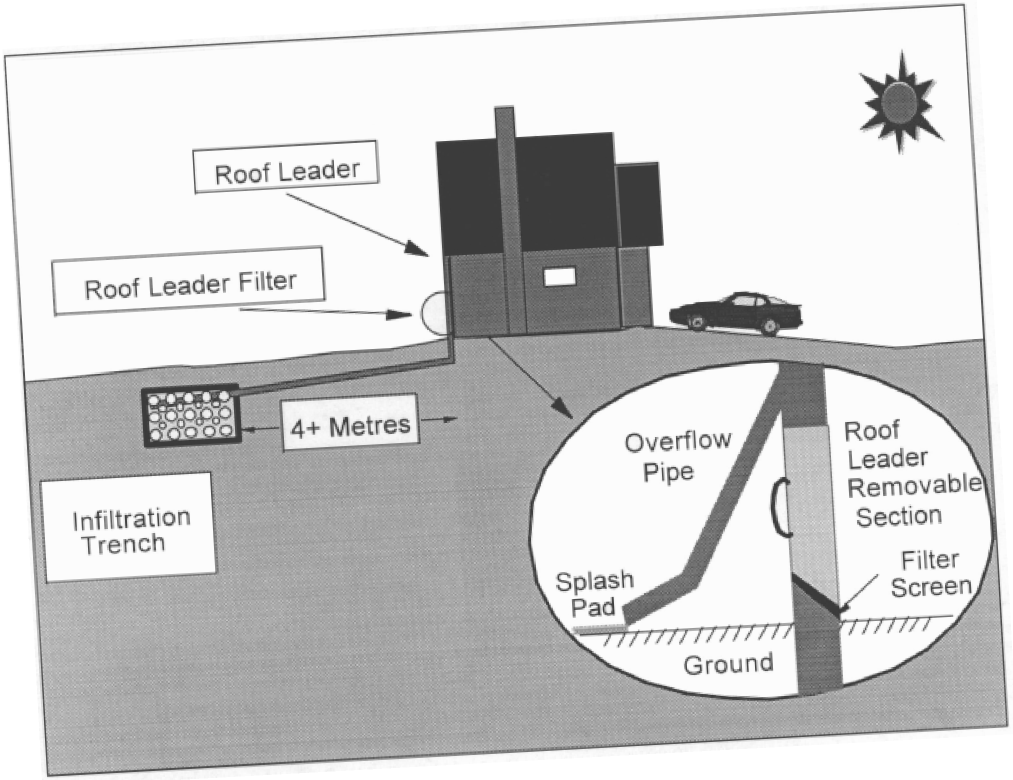
Typical Infiltration Basin Design



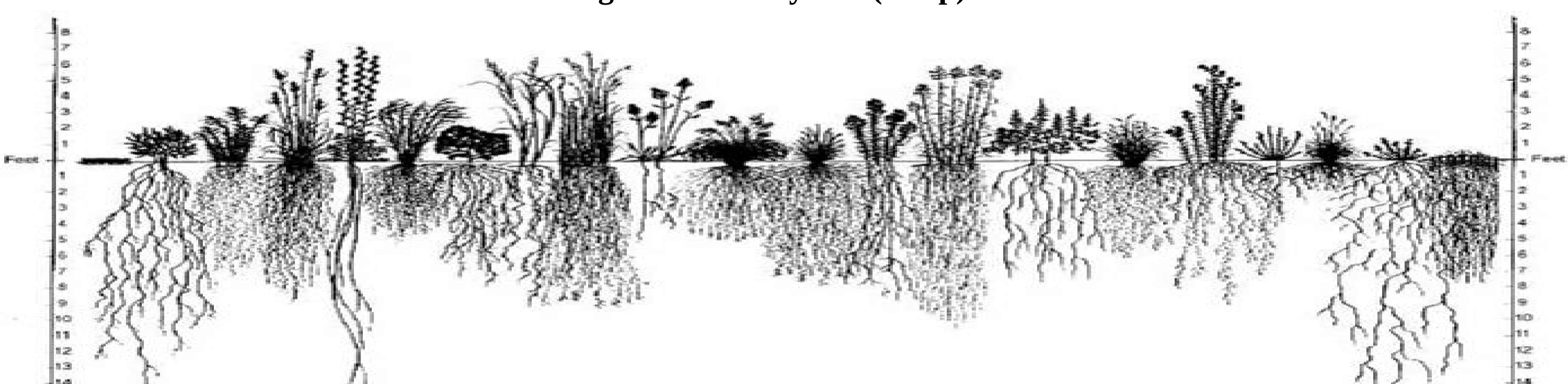
Typical Infiltration Trench Design



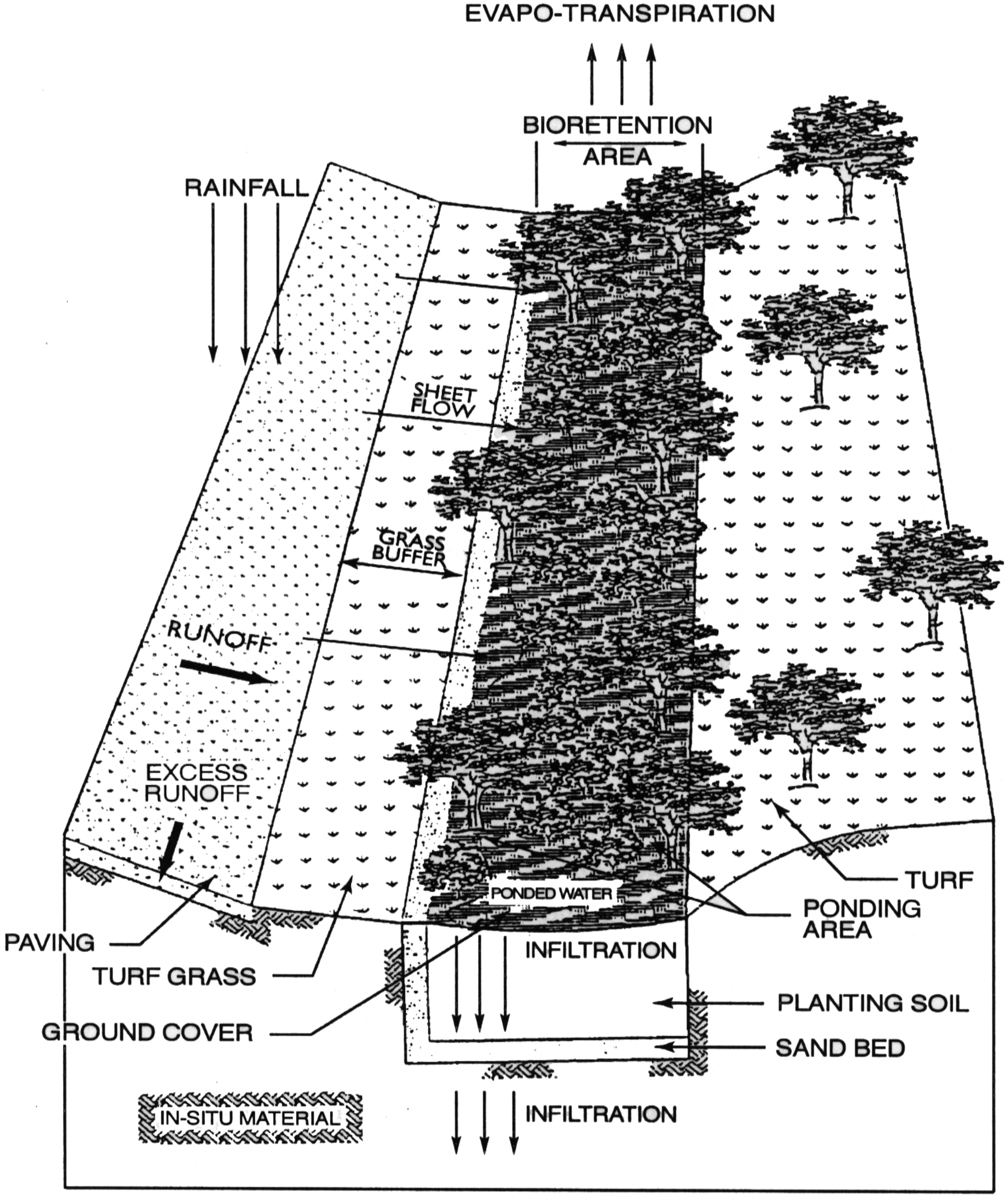
Source: Metropolitan Council – Environmental Services

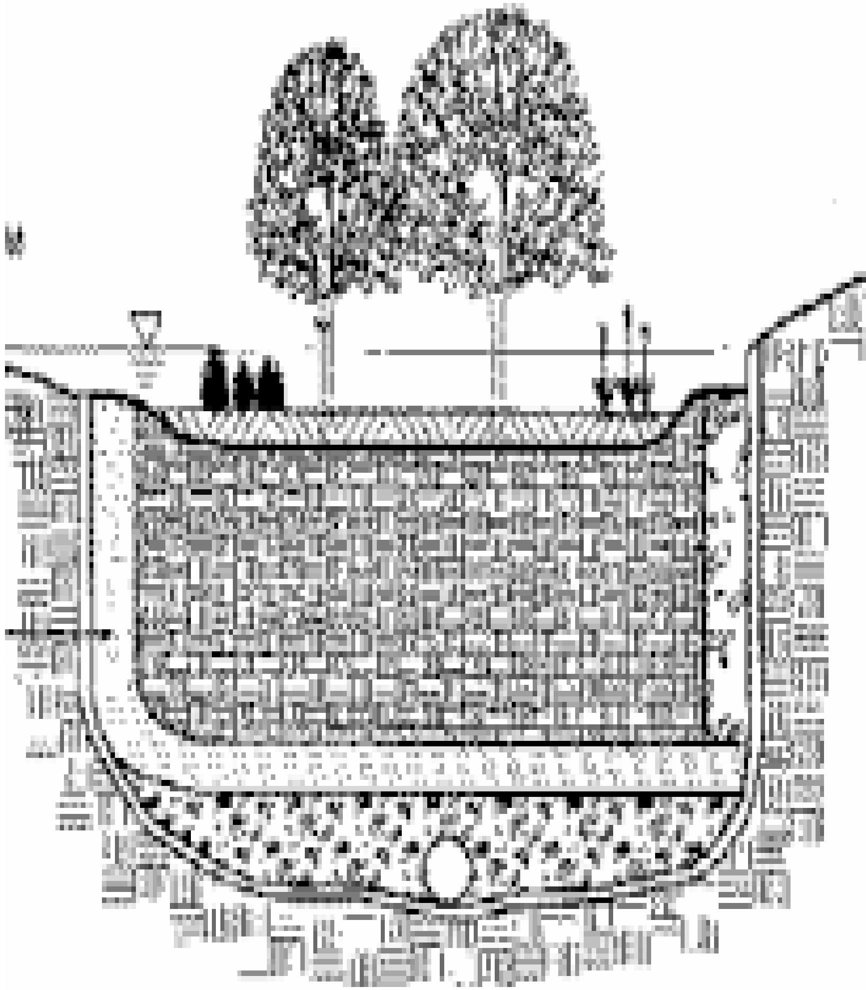


Roof Leader Discharge Soak – away Pits (sump)



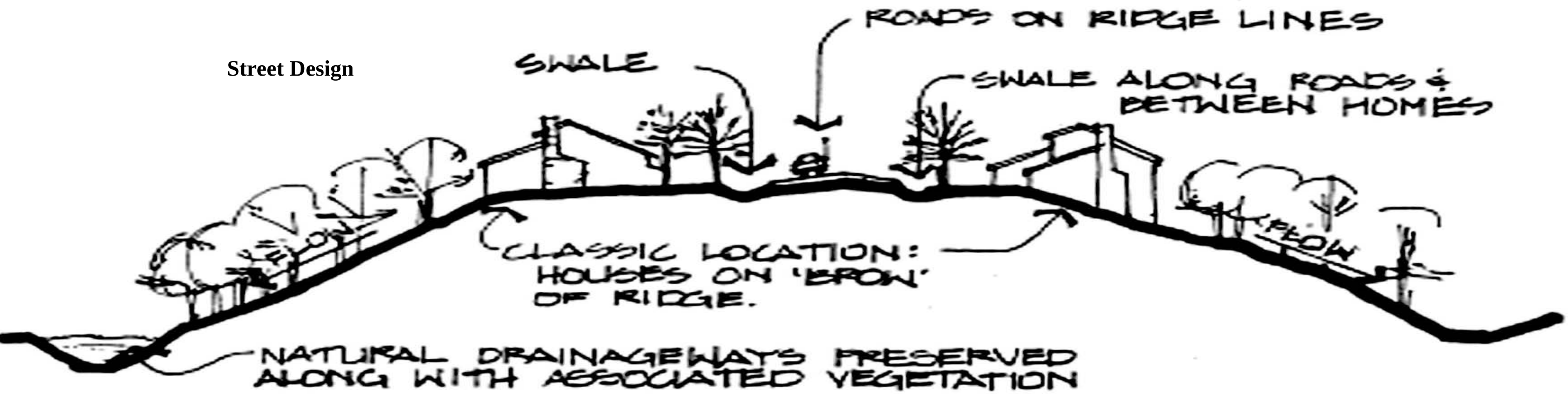
Bioretention Area Conceptual Layout
(functioning like an Infiltration Basin)

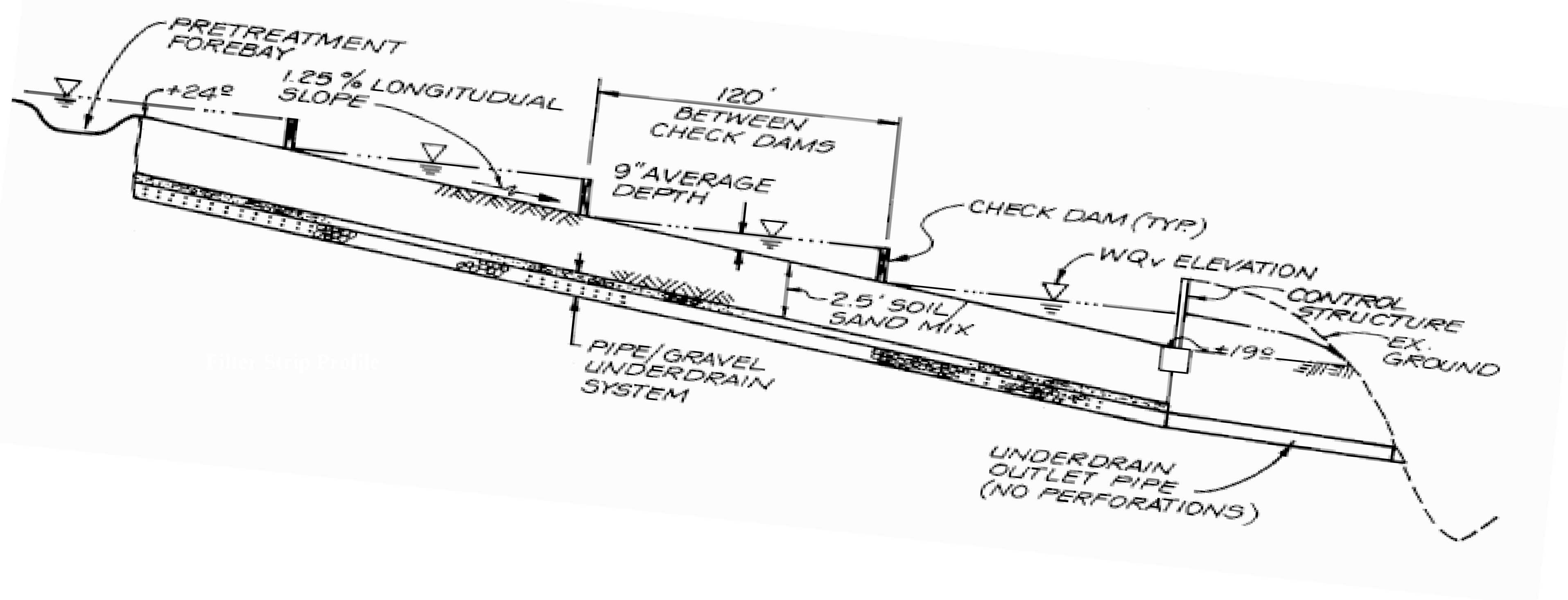




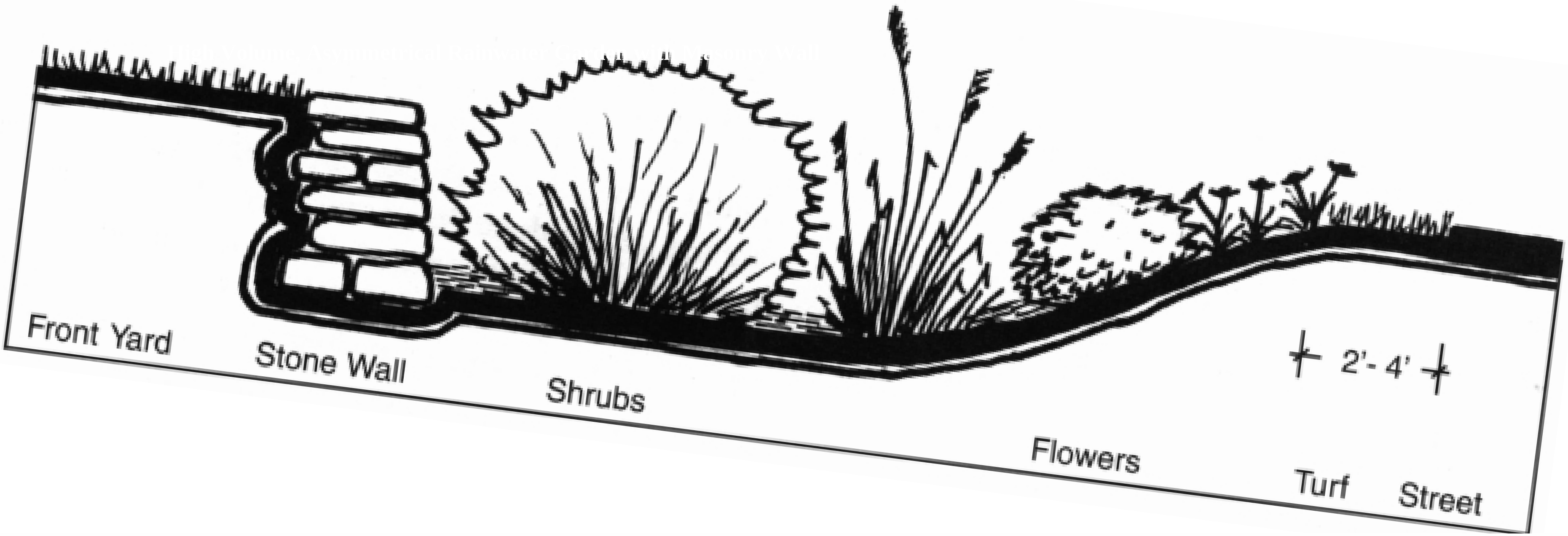
The Bioretention Concept

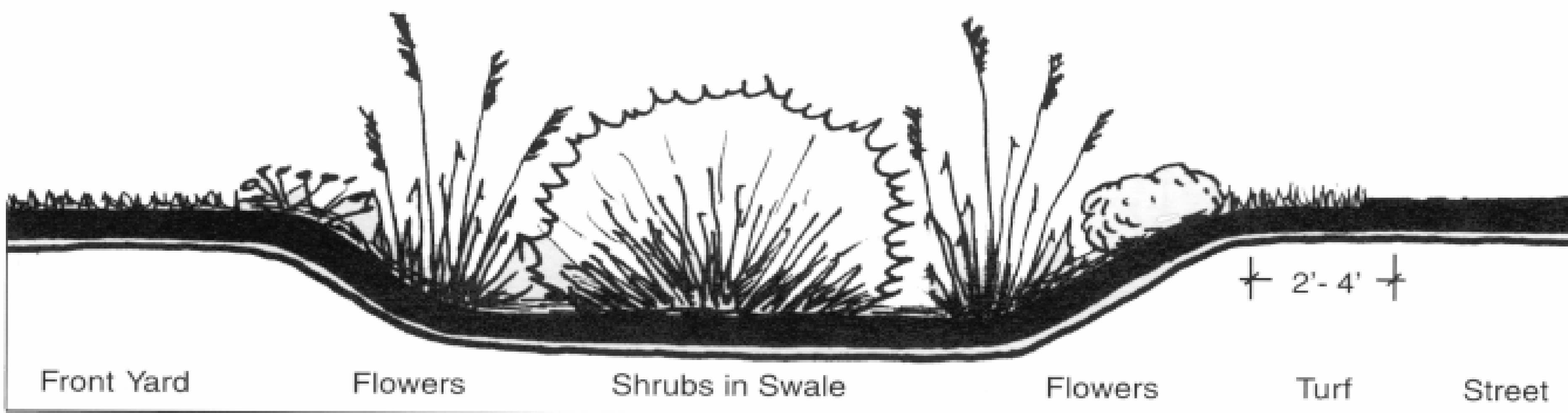
Street Design



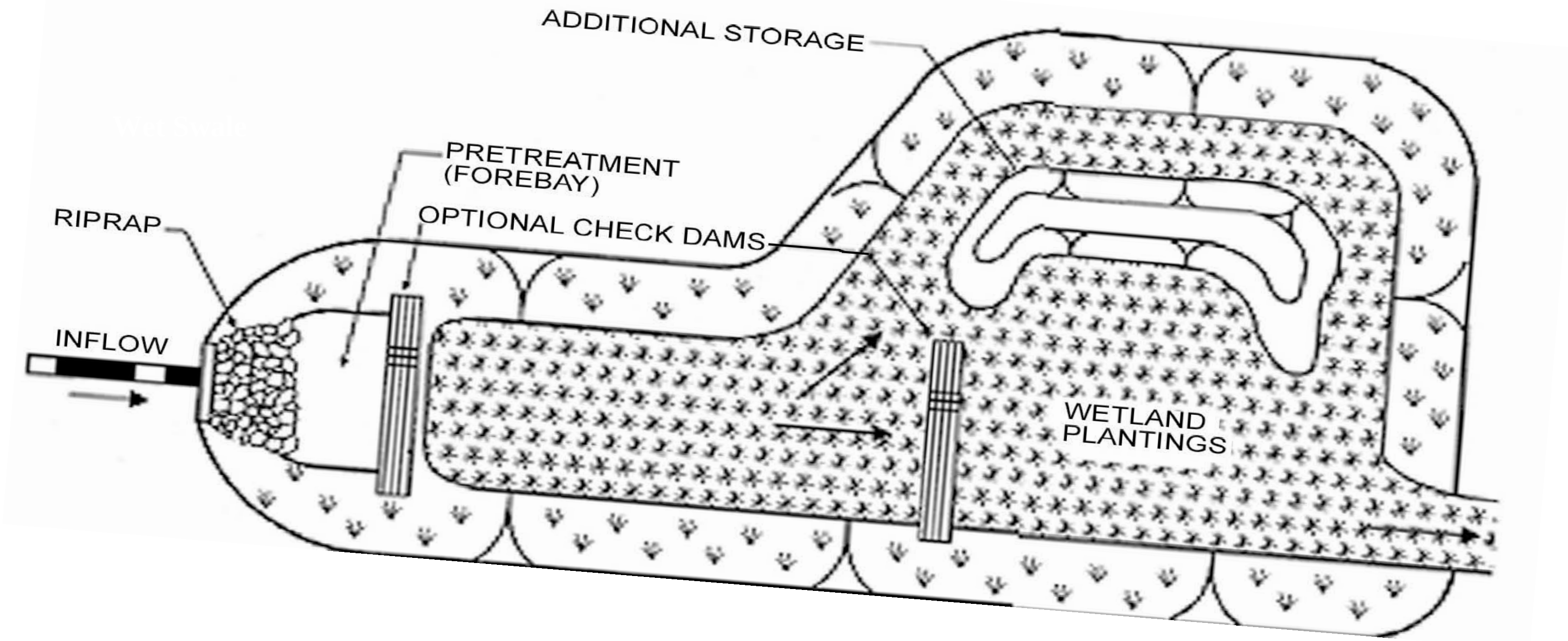


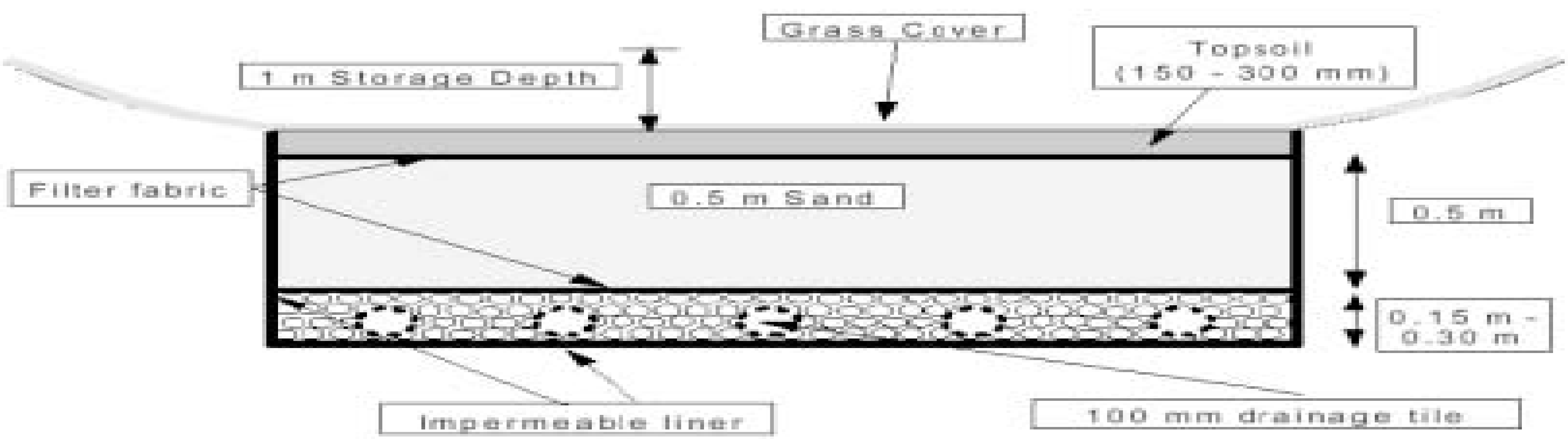
Filter Strip Profile



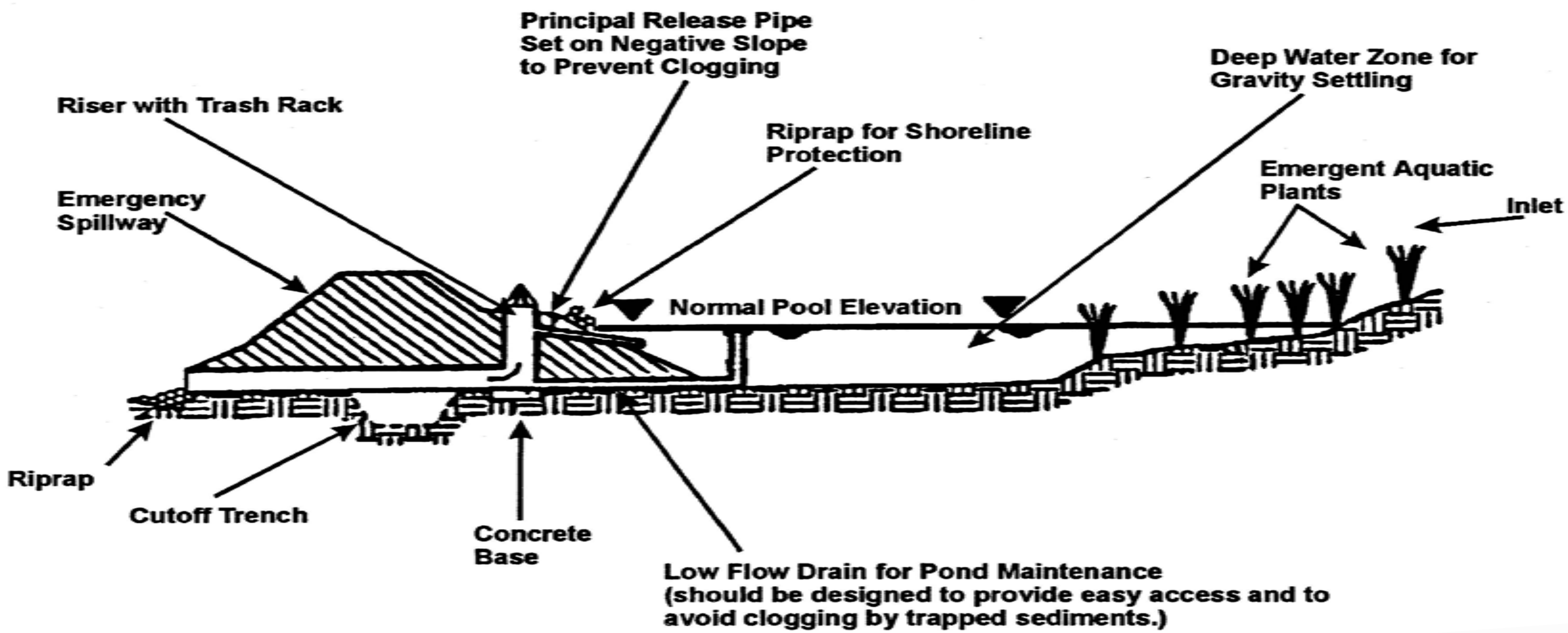


High Volume Symmetrical Rainwater Garden

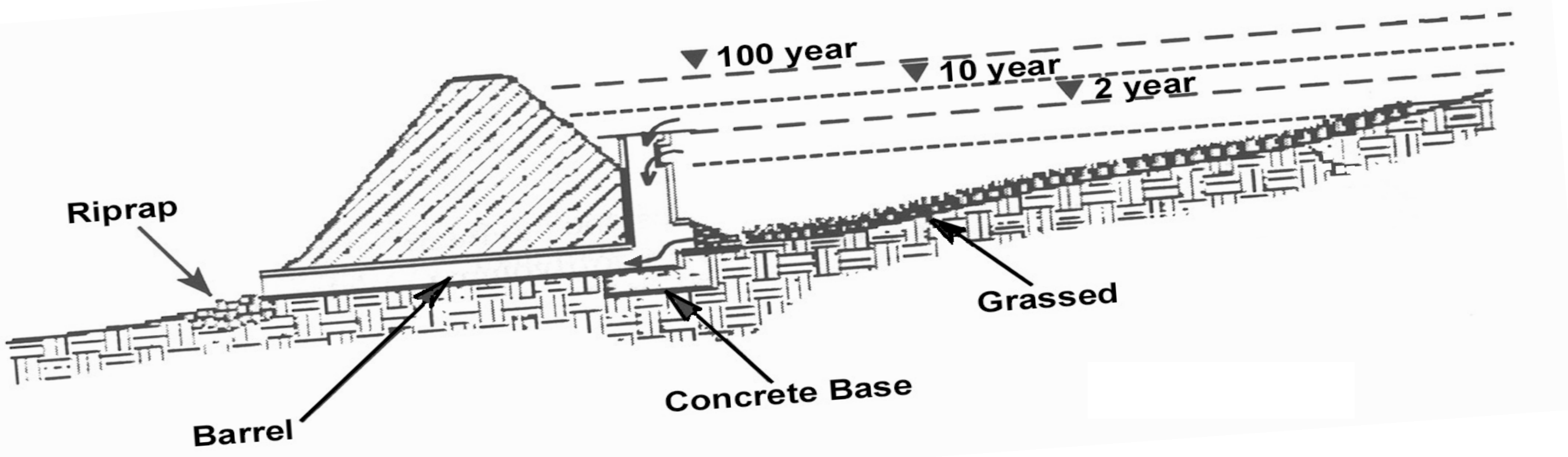




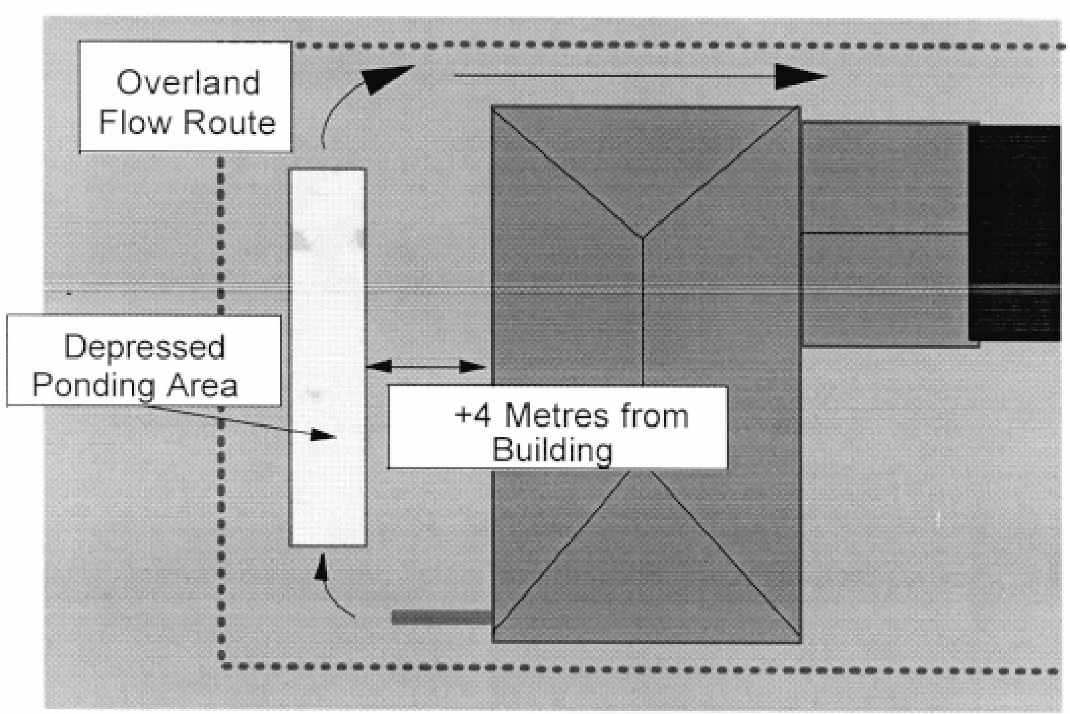
Sand Filter Cross Section

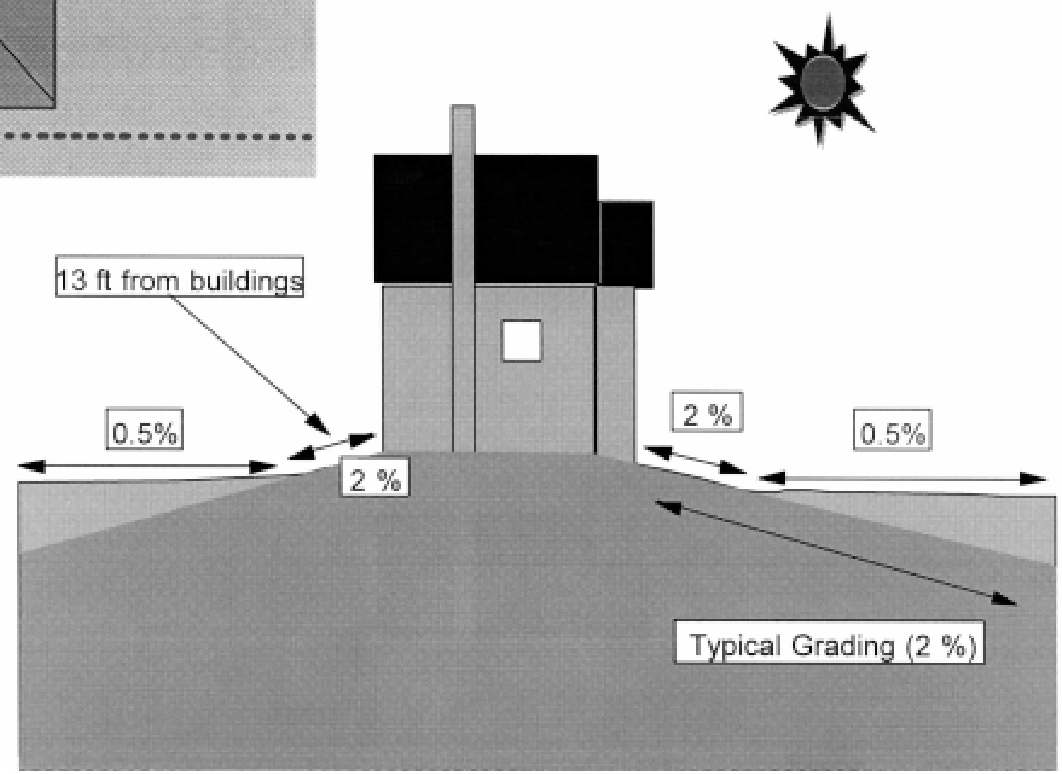


Principal Release Pipe
Set on Negative Slope
to Prevent Clogging
Deep Water Zone for
Gravity Settling
Riser with Trash Rack
Riprap for Shoreline
Protection
Emergent Aquatic
Plants
Emergency
Spillway
Inlet
Normal Pool Elevation
Riprap
Cutoff Trench
Concrete
Base
Low Flow Drain for Pond Maintenance
(should be designed to provide easy access and to
avoid clogging by trapped sediments.)



100 year
10 year
2 year
Riprap
Grassed
Concrete Base
Barrel





Example of Lot Grading changes

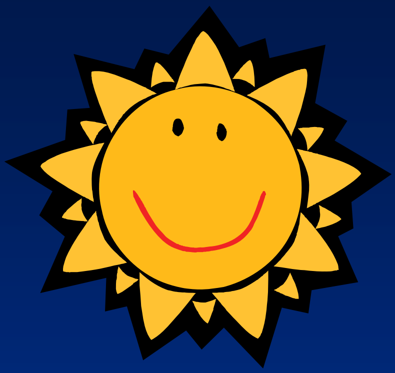
Tyler Coulee
Storm Water Master Plan
City of Bismarck

APPENDIX K

Tyler Coulee Watershed
Aerial Perspective

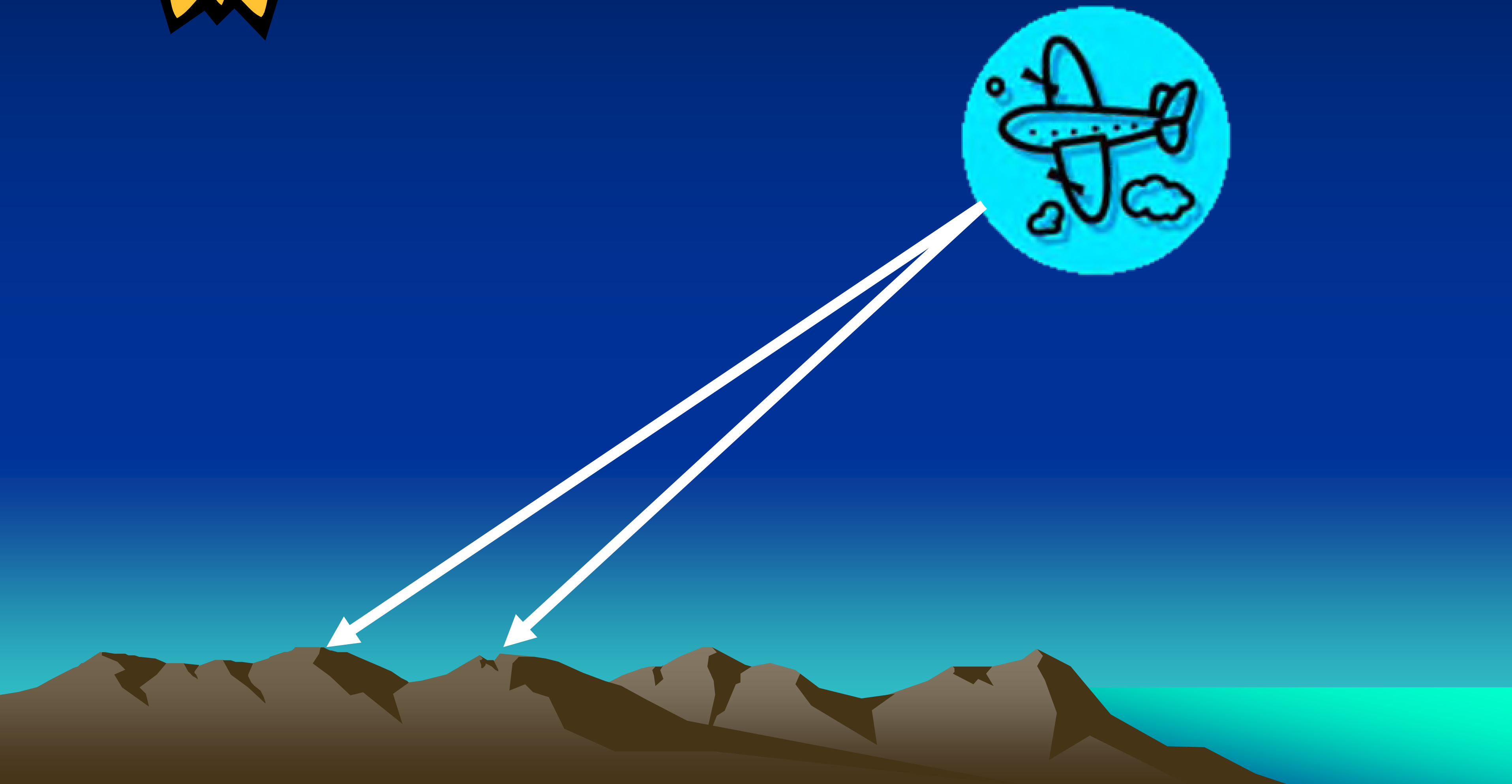
Houston Engineering, Inc. 3712 Lockport Street BISMARCK, NORTH DAKOTA 58501 TEL: (701) 323-0200 FAX: (701) 323-0300	Drawn by MRS	Date 3-22-06	TYLER COULEE WATERSHED	AERIAL VIEW
	Checked by MHG	Scale NONE	STORMWATER MASTER PLAN	TYLER COULEE WATERSHED
			BISMARCK, NORTH DAKOTA	PROJECT NO. 4489-000

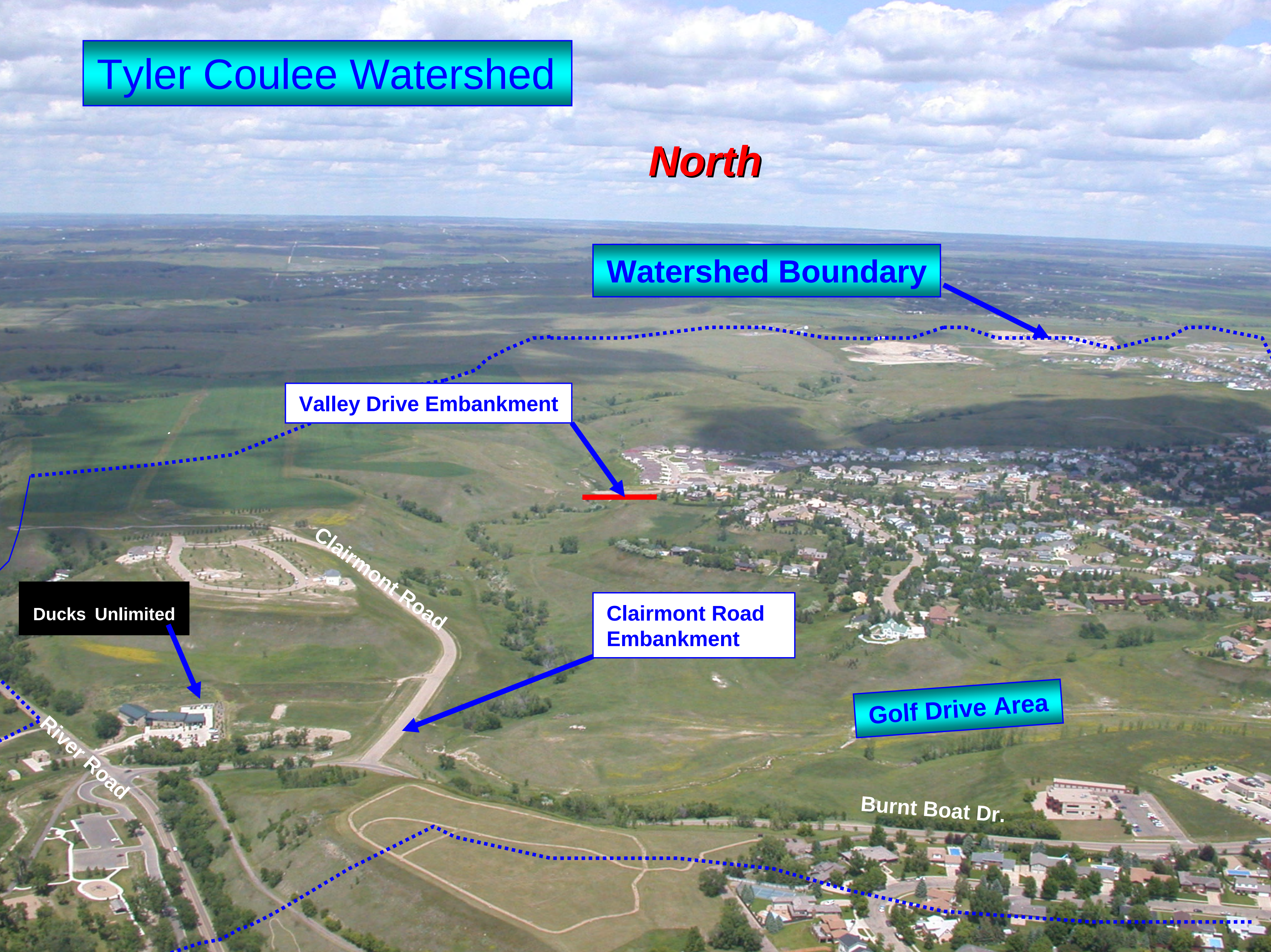
Q:\Projects\Tyler Coulee 4489-000\dwg\Location Map.dwg-22X34 Portrait-1/31/2007 11:40 AM-(msteele)



Tyler Coulee Watershed an Aerial Perspective

June 29, 2004



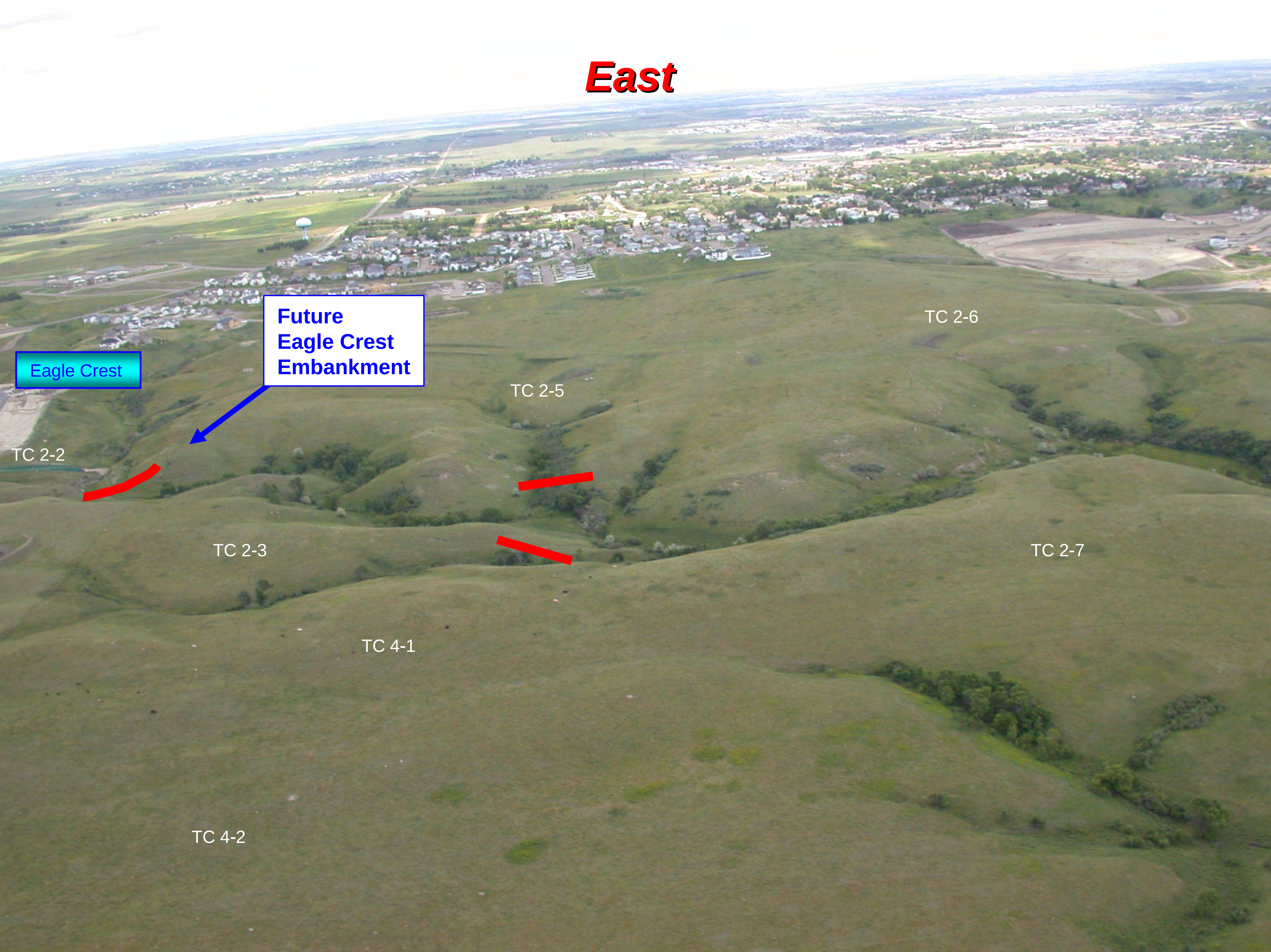

Tyler Coulee Watershed
North
Watershed Boundary
Valley Drive Embankment
Clairmont Road
Ducks Unlimited
Clairmont Road Embankment
Golf Drive Area
River Road
Burnt Boat Dr.

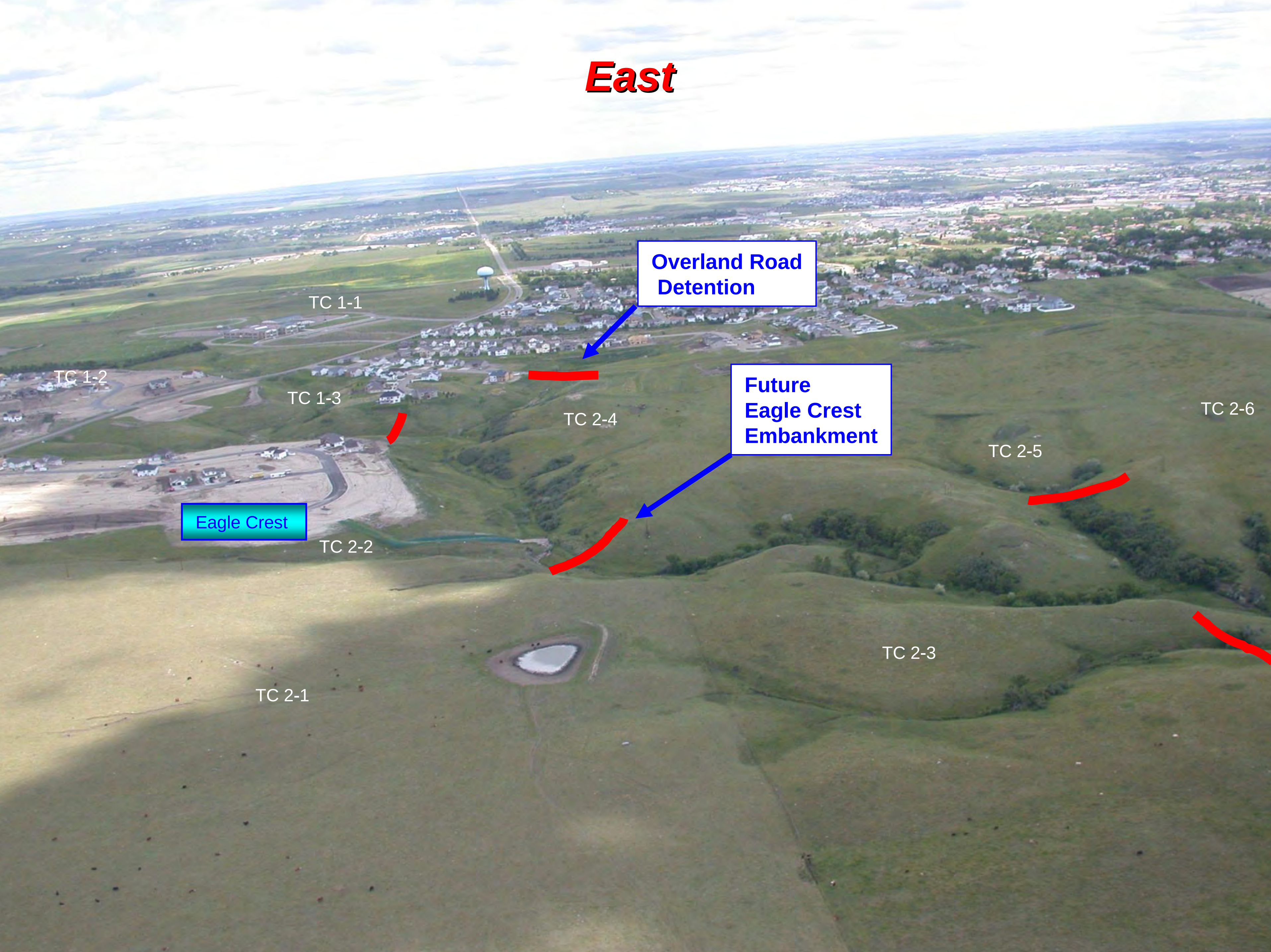

Southeast
Interstate #94
Golf Drive Area
TC 5-3
TC 6-4
TC 5-4
Clairmont Road
Tyler Coulee Channel
TC 5-5
Promontory Point
TC 5-1

East
Morgan Court North
Morgan Court South
TC 5-3
TC 5-2
TC 5-4
Valley Drive Embankment
Tyler Coulee Channel
TC 4-4
TC 5-1
TC 5-5

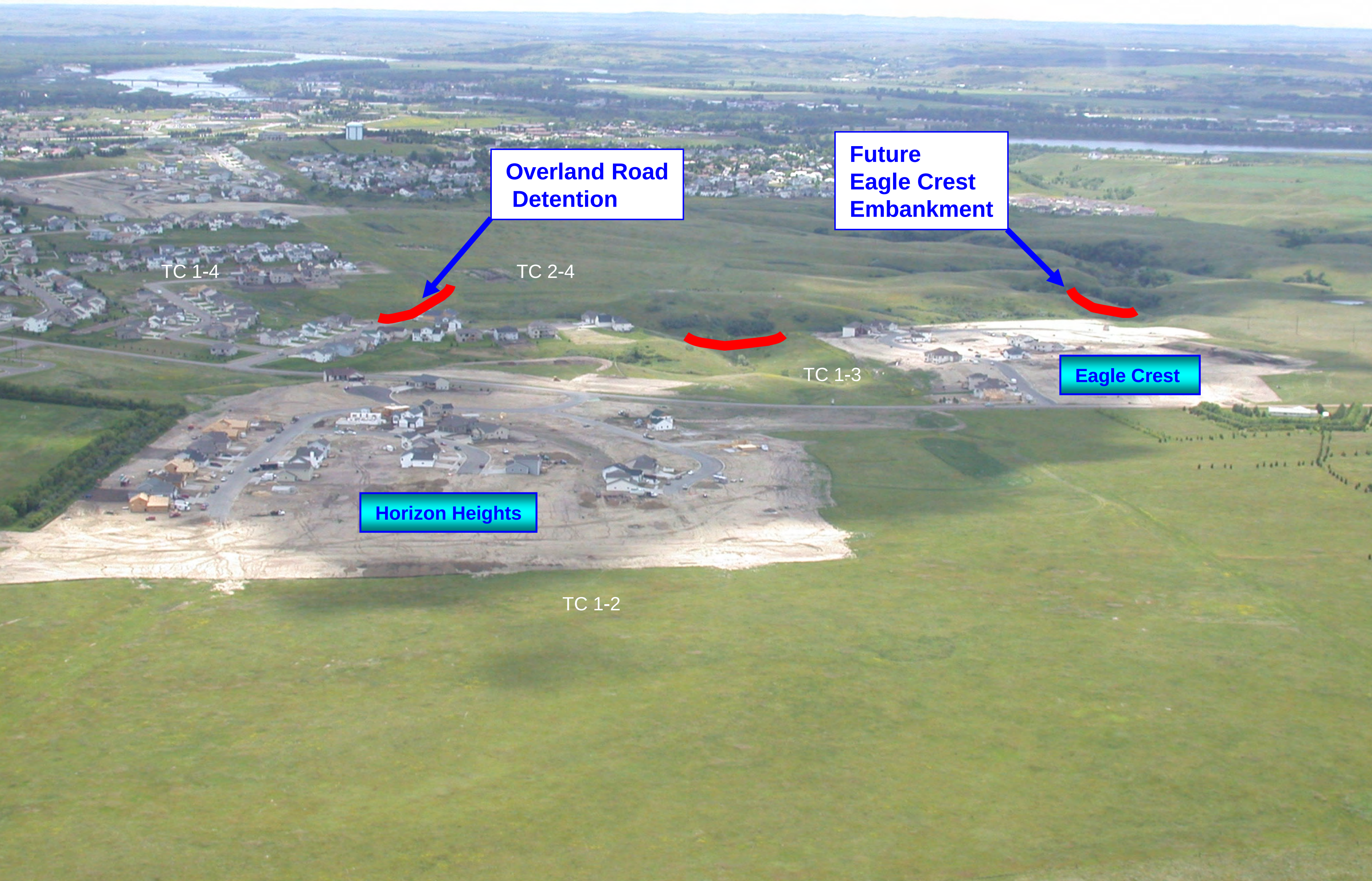

East
TC 3-3
Morgan Court North
Morgan Court South
TC 3-4
TC 4-5
Valley Drive
Valley Drive Embankment
TC 5-3
Mesquite Loop
TC 5-2
TC 4-3
Future Valley Drive
TC 4-4
TC 5-2


East
TC 2-6
Valley Drive East Detention
TC 3-2
TC 2-7
Future Tyler Parkway
Future Tyler Parkway Embankment
TC 4-1
TC 4-3
TC 4-2

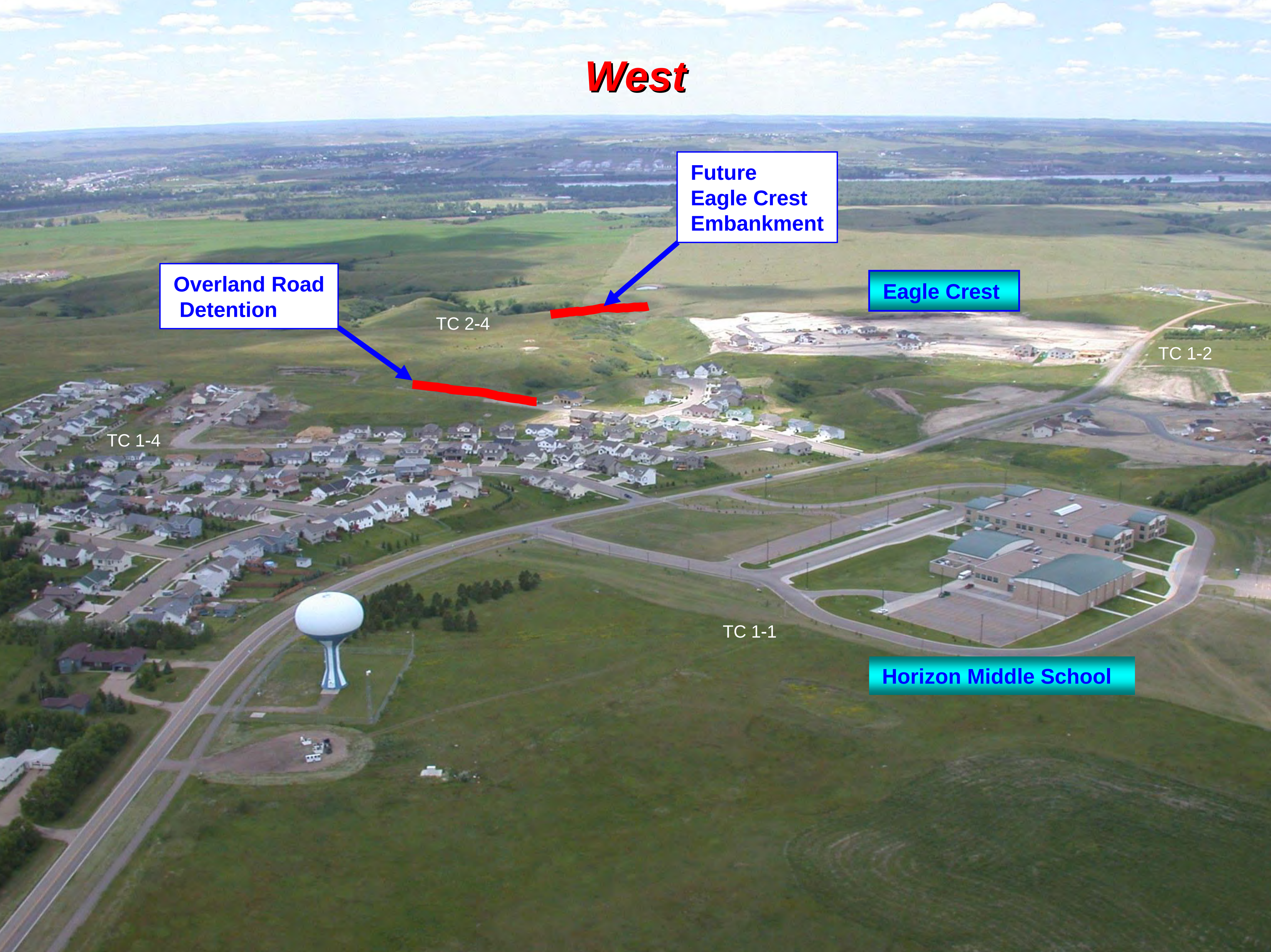

East
Future
Eagle Crest
Embankment
Eagle Crest
TC 2-2
TC 2-3
TC 2-5
TC 2-6
TC 2-7
TC 4-1
TC 4-2

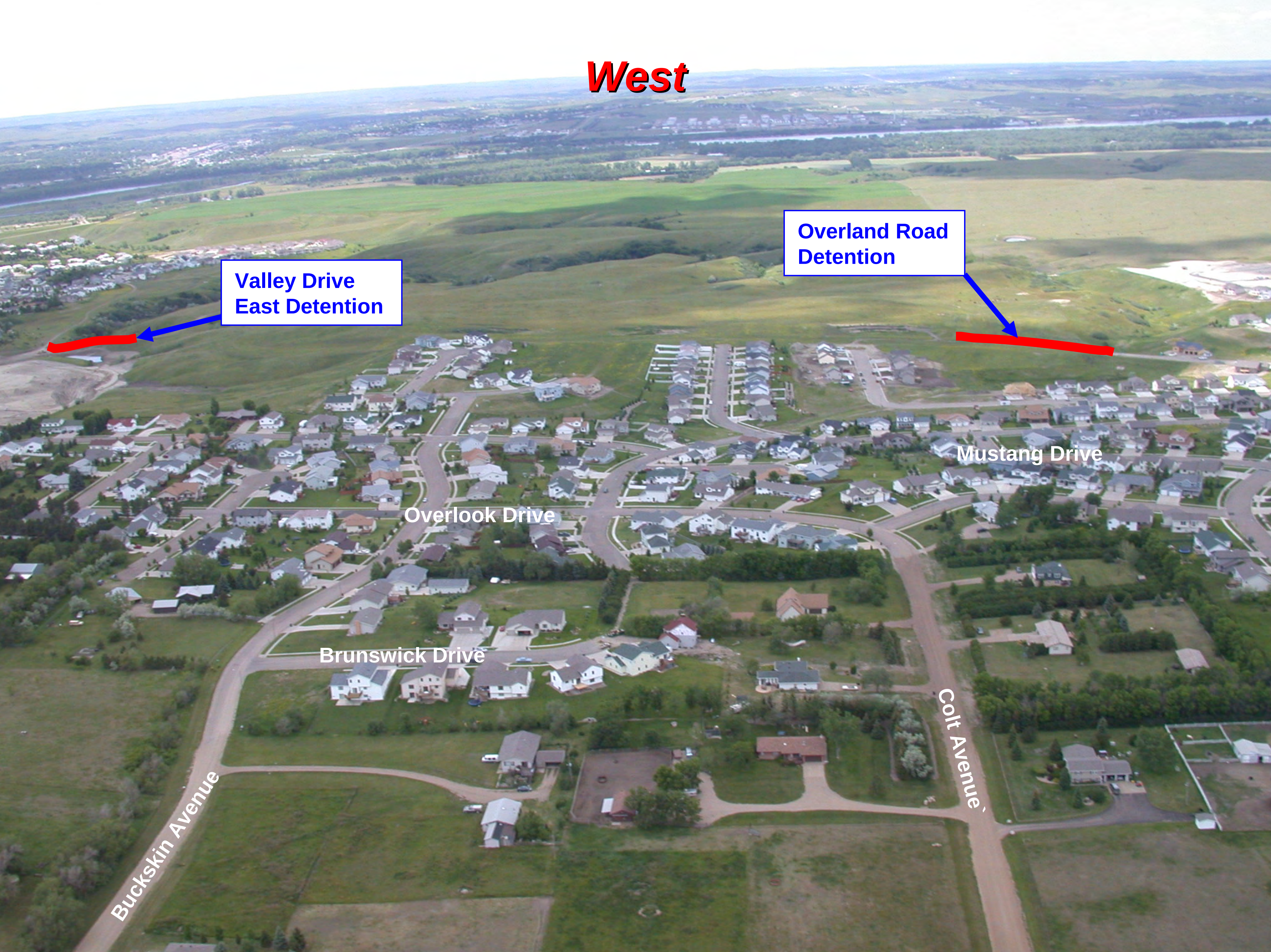

East
Overland Road
Detention
TC 1-1
TC 1-2
TC 1-3
TC 2-4
Future
Eagle Crest
Embankment
TC 2-6
TC 2-5
Eagle Crest
TC 2-2
TC 2-3
TC 2-1

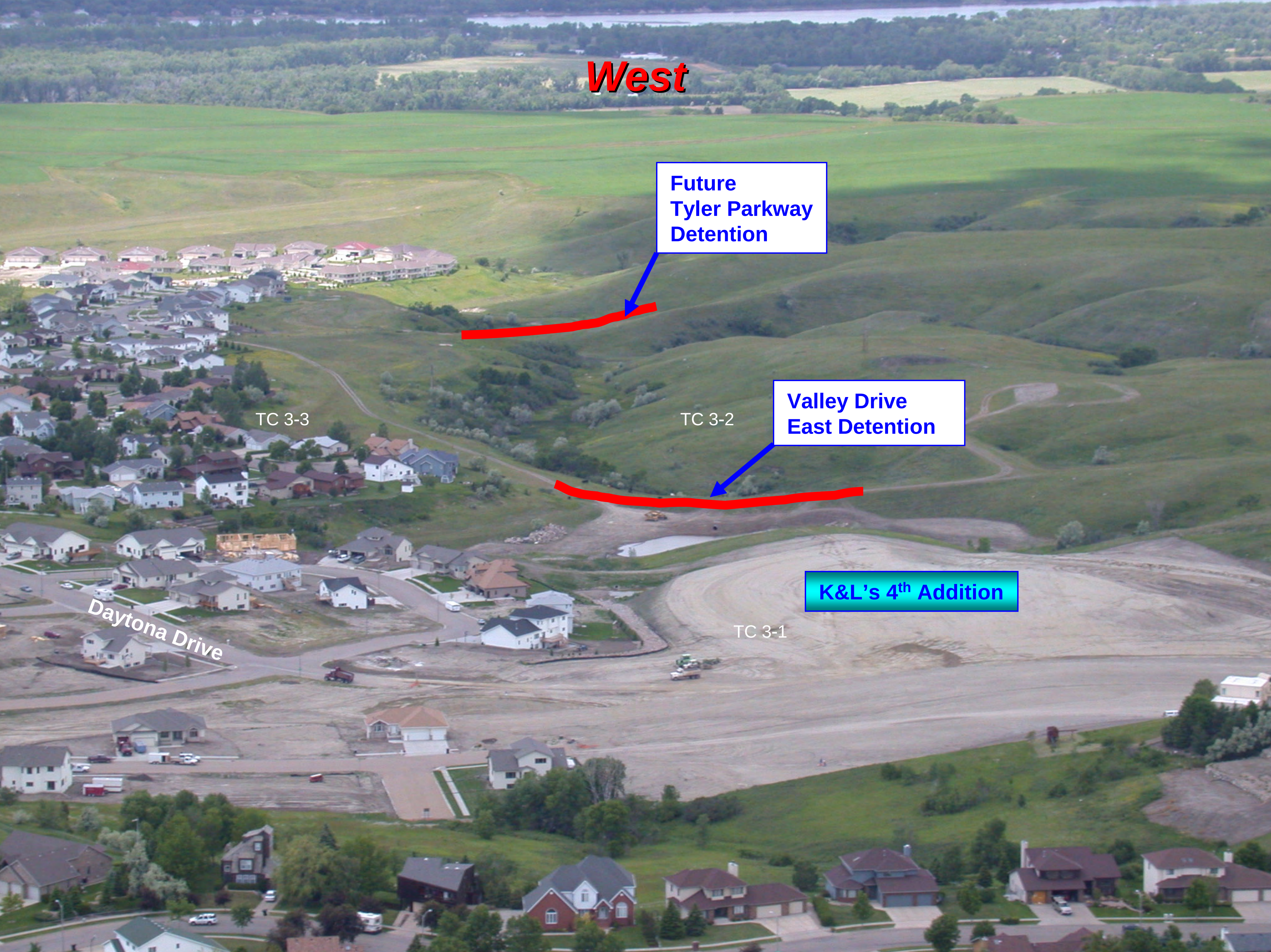
West



Overland Road Detention
Future Eagle Crest Embankment
TC 1-4
TC 2-4
TC 1-3
Eagle Crest
Horizon Heights
TC 1-2


West
Future
Eagle Crest
Embankment
Overland Road
Detention
Eagle Crest
TC 2-4
TC 1-2
TC 1-4
TC 1-1
Horizon Middle School


West
Valley Drive
East Detention
Overland Road
Detention
Mustang Drive
Overlook Drive
Brunswick Drive
Colt Avenue
Buckskin Avenue


West
Future
Tyler Parkway
Detention
TC 3-3
TC 3-2
Valley Drive
East Detention
K&L's 4th Addition
TC 3-1
Daytona Drive

North
MDU Campus
TC 6-2
TC 6-1
Century Avenue
Capitol
Credit Union
TC 6-3
TC 6-4
Future Lowe's
and Kohl's Site
McDonald's
Tyler Parkway/Divide Avenue
Interstate 94