TOWN OF LYONS

STORM DRAINAGE CRITERIA ADDENDUM

TO URBAN DRAINAGE STORM DRAINAGE CRITERIA MANUALS (VOLUMES 1, 2, AND 3)

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Purpose of this Manual

The purpose of this manual is to set forth the criteria to be used in the design of drainage systems within the Town of Lyons, Colorado. All subdivision plats, planned unit development, or any other proposed construction must include adequate storm drainage analysis using this manual supplemented by the UDSCM and Boulder County criteria as a guide.

Whenever possible master drainage plan studies should be referenced for proposed developments located within the study area. Although the Town of Lyons lies outside of the Urban Drainage and Flood Control District, the regional drainage concepts written in the Urban Storm Drainage Criteria Manual (USDCM) can be applied to Lyons. Many of the communities outside of Denver have also adopted the UDSCM for their communities with an addendum to fit their specific community needs.

All section numbers referenced are based off of USDCM Volumes 1, and 2 dated June 2001 Revised April 2008, and USDCM Volume 3 dated November 2010 available for download from their website at www.udfcd.org.

Prior to any construction of development activity, there must be an adequate plan for storm drainage in compliance with all regulations and specifications set forth in this Manual and approved by the Town.

Master Drainage Study

Any annexation or planned unit development (PUD) in excess of 40 acres or phased commercial/industrial development in excess of 10 acres is required to prepare a master drainage study. The purpose of the study is to identify major drainageways, ponding areas, siting and sizing of culverts, bridges, open channels and drainage basins which are tributary to the proposed development. The master drainage study should discuss alternatives to the drainage problems identified by the study. Downstream drainage facilities should be thoroughly analyzed to confirm they can convey the developed runoff. The report shall include but not be limited to:

- Calculations for peak flow from all off-site tributary drainage basins.
- Calculations for peak flow within the proposed development.
- Discussion and analysis of downstream facilities.
- Discussion of drainage problems and solutions which may be anticipated to occur within the development.
- Reports shall be bound and typed on 8-1/2” x 11” paper.

The drawings shall include, but not limited to the following information:

- Any and all flood plains
- Existing topography (Two-foot intervals)
- Location and size of open channels, bridges, culverts, storm sewers, and ponding areas.
- Identification of drainage basins within and tributary to the development.
- Location of all streets.

- Scales as small as 1"=500' may be used to show the entire development and all off-site drainage areas. (Drawings shall be 22" x 34").

Preliminary Drainage Report

A preliminary drainage report must be approved prior to approval of any final plat, planned building group or planned unit development. The report must be approved by engineering and planning staff prior to Planning Commission action. A Planning Commission action without engineering approval risks violation of State statues for water rights, floodplain regulations, and other water resource criterion.

The purpose of the preliminary drainage study is to identify and propose specific solutions to any on-site drainage problems that will occur as a result of the proposed development. Off-site information required on the preliminary drainage study is similar to that of the master drainage study and may be omitted from the preliminary drainage study when adequately analyzed by a master drainage study. The preliminary drainage report must include adequate topography to verify all conclusions regarding off-site drainage. Unless known, the capacity of downstream drainage structures must be thoroughly analyzed to determine their ability to convey the developed discharge.

Whenever the possibility of downstream flooding or property damage exists, it will be necessary to utilize either detention or retention ponds to reduce the developed discharge to an acceptable rate.

The preliminary drainage report shall include, but not limited to:

- A description of the property (Township, Range, Section, surrounding developments, major drainage channels, general topography, ground cover).
- Detailed analysis of receiving structures
- Adequate on-site analysis to determine the location and required capacity of culverts, bridges, open channels, detention ponds and storm sewers
- Report shall be bound and typed on 8-1/2" x 11" paper. Drawings, figures, plates, and tables shall be bound with the report or included in a folder/pocket attached to the report.

Drawings accompanying the report shall include, but not limited to, the following:

- Scales as small as 1"=500' may be used to show the entire development and all off-site drainage areas. (Drawings shall be 22" x 34").
- All floodplains affecting the property must be shown.
- Topography map of the development showing street layout and/or building location on a contour interval not to exceed two feet
- Location and size of all drainage structures
- Drainage patterns within the proposed developments

Whenever open channels are planned, the following additional information shall be required:

- Preliminary profile showing existing and proposed grades

- Cross sections on 100-foot stations showing existing and proposed cross sections and required right-of-way
- Location and size of all structures
- As-built profiles of any existing utilities which may be affected by the channel construction.

Inlet and storm sewer size calculations are not required with the preliminary drainage study because the number of subbasins analyzed in the report should be held to the smallest practical amount.

Final Drainage Report

The final drainage report shall be a detailed study and analysis of the proposed development. It shall include detailed calculations for all runoff within the proposed development, and detailed calculations for the design of all drainage structures within the development. The final drainage report shall be typed on 8-1/2" x 11" paper. Drawings, figures, plates, and/or tables shall be bound with the report or included in a folder/pocket attached to the report.

Construction plans for all drainage structures, grading plans and street grades, where applicable, shall also be included with and considered as a part of the final drainage study.

Drawings and calculations comprising the final drainage report shall include but not limited to:

- Existing and proposed contours (Two-foot intervals)
- Location and elevations of city benchmarks. All elevations shall be on a NAVD 88 datum.
- Property lines
- Street, names and grades
- Existing drainage facilities and structures, including existing irrigation ditches, roadside ditches, drainageways, swales, gutter flow directions, culverts, etc. All pertinent information such as size, shape, slope, location, etc., shall also be included to facilitate review and approval of drainage plans.
- Overall drainage area boundary and drainage subarea boundaries
- Proposed type of curb and gutter, gutter flow direction, including cross pans.
- Proposed storm sewers and open drainageways and right-of-way requirements, including proposed inlets, manholes, culverts, erosion control and energy dissipation devices, and other appurtenances.
- Proposed outfall point for runoff from the developed area and facilities to convey flows to the final outfall point without damage to downstream properties.
- Routing and accumulative flows at various critical points for the minor storm runoff
- Routing and accumulative flows at various critical points for the major storm runoff
- Details of detention storage facilities and outlet works.
- Critical minimum finished floor elevations for protection from major storm runoff.
- An overall drawing of the proposed development which shall show the following information:
    - Location and size of all drainage structures
    - General flow patterns within the development

- Finished floor elevations of all buildings
- Flood level in all streets in which the curb is overtopped during the 100-year storm.
- All drainage basins within the development.
- All floodplains within the proposed development
- Location and elevation of all existing and proposed utilities affected by or affecting the drainage design
- All drawings shall be on 22” x 34” sheets.

USDCM VOLUME 1

DRAINAGE POLICY

1.1 Policy – Accepted

1.2 Principles – Accepted

1.3 Basic Knowledge – Accepted

1.4 Planning – Accepted

Change:

“A master plan for storm drainage should be developed and maintained in an up-to-date fashion at all times for each urbanizing drainage watershed in the Denver region.”

To:

“The town Masterplan should be updated based on annexations, hydrologic study changes by FEMA, CWCB, or other agencies, and following capital improvement projects, or not less than every five (5) years.”

1.5 Technical Issues– Accepted

Change:

“Proper design and construction of stormwater detention and retention basins are necessary to minimize future maintenance and operating costs to avoid public nuisances and health hazards. This is particularly important, given the many detention and retention facilities in the Denver region.”

To:

Proper design and construction of stormwater detention basins are necessary to minimize future maintenance and operating costs to avoid public nuisances and health hazards.

Change:

“The various governmental agencies within the Denver region have adopted and need to maintain their floodplain management programs.”

To:

The Town of Lyons has adopted the FEMA NFIP floodplain ordinance as required by the CWCB and needs to maintain their floodplain management programs.

1.6 Flood Insurance – Accepted

1.7 Implementation – Accepted

2.0 PRINCIPLES

2.1 Drainage Is a Regional Phenomenon That Does Not Respect the Boundaries Between Government Jurisdictions or Between Properties – Accepted

2.2 A Storm Drainage System Is a Subsystem of the Total Urban Water Resource System – Accepted

2.3 Every Urban Area Has an Initial (i.e., Minor) and a Major Drainage System, Whether or Not They Are Actually Planned and Designed – Accepted

2.4 Runoff Routing Is Primarily a Space Allocation Problem – Accepted

2.5 Planning and Design of Stormwater Drainage Systems Generally Should Not Be Based on the Premise That Problems Can Be Transferred From One Location to Another – Accepted

2.6 An Urban Storm Drainage Strategy Should Be a Multi-Objective and Multi-Means Effort – Accepted

2.7 Design of the Stormwater Drainage System Should Consider the Features and Functions of the Existing Drainage System – Accepted

2.8 In New Developments, Attempts Should Be Made to Reduce Stormwater Runoff Rates and Pollutant Load Increases After Development to the Maximum Extent Practicable – Accepted

2.9 The Stormwater Management System Should Be Designed Beginning With the Outlet or Point of Outflow From the Project, Giving Full Consideration to Downstream Effects and the Effects of Off-Site Flows Entering the System – Accepted

2.10 The Stormwater Management System Should Receive Regular Maintenance – Accepted

2.11 Floodplains Need to Be Preserved Whenever Feasible and Practicable – Accepted

2.12 Reserve Sufficient Right-of-Way for Lateral Movement of Incised Floodplains – Accepted

3.0 BASIC KNOWLEDGE – Deleted *(Although the concepts by title are valuable to the Town of Lyons, the content is UDFCD specific and is therefore deleted to avoid confusion. i.e. 3.1.4 Library references plans and reports within the UDFCD.)*

3.1 Data Collection - Deleted

3.1.1 Storm Runoff and Flood Damage - Deleted

3.1.2 Rainfall-Runoff Relationships - Deleted

3.1.3 Inventory of Successful Projects - Deleted

3.1.4 Library - Deleted

3.1.5 Runoff Magnitudes - Deleted

3.2 Floodplain Data - Deleted

3.2.1 Small Waterways - Deleted

3.2.2 Data Inventory - Deleted

3.2.3 Floodplains - Deleted

3.2.4 Priority for Data Acquisition - Deleted

3.3 Data Use - Deleted

3.3.1 Master Plan - Deleted

3.3.2 Public Cost - Deleted

3.3.3 Easements - Deleted

4.0 PLANNING

4.1 Total Urban System - Amended

Change:

"Master plans for storm drainage have been developed and maintained in an up-to-date fashion for most of the watersheds in the Denver region. An effort to complete the coverage of master plans for yet unplanned areas of the District should be continued until full coverage is achieved."

To:

"The Town Master Plan should be updated based on annexations, hydrologic study changes by FEMA, CWCB, or other agencies, and following capital improvement projects, or not less than every five (5) years."

4.1.1 Development Plan - Accepted

4.1.2 Master Plan- Amended- Amended

Delete entire first paragraph

Change:

"The District has established a suitable format for master plan reports and drawings so that a uniform planning approach and coordination of efforts can more easily be made. Master planning should be done in enough detail and with adequate thoroughness to provide a ready drainage development guide for the future in a particular watershed. "

To:

"Any master plan for the town should be done in enough detail and with adequate thoroughness to provide a ready drainage development guide for the future. Guidelines for drainage reports are provided in sections for the Master Drainage Study, Preliminary Drainage Report, and Final Drainage Report."

4.1.3 Planning Process Ingredients- Amended

Change:

"2. Initial Drainage System Planning. All local and regional planning must take into consideration the initial drainage system to transport the runoff from storms expected to occur once every 2 to 10 years."

To:

2. Initial Drainage System Planning. All local and regional planning must take into consideration the initial drainage system to transport the runoff from storms expected to occur once every 2 years.

4.1.4 Local and Regional Planning- Accepted

4.1.5 Site Planning- Accepted

4.1.6 Water Quality- Amended

Change:

"Sanitary sewage systems that overflow or bypass untreated sewage into surface streams should not be permitted in the Denver region."

To:

Sanitary sewage systems that overflow or bypass untreated sewage into surface streams should not be permitted in the town.

4.2 Multiple-Objective Considerations- Accepted

4.2.1 Lower Drainage Costs- Accepted

4.2.2 Open Space - Accepted

4.2.3 Transportation - Accepted

4.3 Natural Channels- Accepted

4.3.1 Channelization- Amended

Add:

It shall be the policy of the town to review proposed channel designs on a case-by-case basis. Proposed modifications to natural channels shall be approved only if the work causes no injury to water rights and is not in violation of State of Federal Law.

4.3.2 Channel Storage- Accepted

4.3.3 Major Runoff Capacity - Accepted

4.3.4 Maintenance and Maintenance Access- Accepted

4.4 Transfer of Problems- Accepted

4.4.1 Intra-Watershed Transfer- Accepted

4.4.2 Inter-Watershed Transfer- Accepted

4.4.3 Watershed Planning- Accepted

4.5 Detention and Retention Storage- Amended

Add:

"The policy of the Town of Lyons shall be to require regional and/or on-site detention for all future developments. Temporary or interim detention/retention may be required if the downstream regional facilities have not yet been constructed per the applicable Master Plan. It is the town's policy to require detention of runoff from the 100-year storm falling on the developed site and release of the detained water at the rate of the runoff of the 5-year storm falling on the undeveloped site. Detention releases based on soil types are not approved for the town.

Proposed development must provide for the safe conveyance of offsite flows through the proposed development site. Offsite flow may be routed through or around the proposed detention facilities. Positive drainage must be provided. The town will not approve any detention pond that does not drain in less than 72 hours, or causes injury to water rights, or is in violation of State or Federal law.

All detention facilities must be recorded with the State database: Stormwater Detention and Infiltration Facility Notification in compliance with Colorado Revised Statute §37-92-602(8)(b)(I)(A). Additional information is presented on the state website: https://maperture.digitaldataservices.com/gvh/?viewer=cswdif

Owing to the updated guidance from the State Engineer on 72 hour drain time, retention facilities must meet that same threshold. Retention facilities holding water longer than 72 hours are subject to review by the State Engineer for water rights, augmentation, or other basin requirements. At a minimum, any drainage plan proposing retention facilities must prove infiltration rates of soils in the retention facility can empty the pond within 72 hours. Drainage plans proposing retention must also consider clogging pore spaces in the pond bottom, seasonal variation in groundwater and its impact on infiltration rates, and other criteria required by the Town Engineer.

4.5.1 Upstream Storage - Accepted

4.5.2 Minimized Directly Connected Impervious Area Development - Accepted

4.5.3 Downstream Storage - Accepted

4.5.4 Reliance on Non-Flood-Control Reservoirs - Amended

Delete entire paragraph

Add:

"Jurisdictional dams are classified by the State Engineer as low, moderate, or high hazard structures depending on conditions downstream. Dams are classified as high hazard structures when, in the event of failure, there is a potential loss of life. Dams presently rated as low or moderate hazard structures may be changed to high hazard rating if development occurs within the potential path of flooding due to a dam breach. In this case, the reservoir owners would be liable for the cost of upgrading the structure to meet the higher hazard classification.

The Policy of the Town of Lyons shall be to:

1. Restrict upstream development to areas outside of the jurisdictional dam water surface elevation created by a 100-year storm plus freeboard.

2. Restrict downstream development to areas outside of the jurisdictional dam 100-year floodplain. The jurisdictional dam 100-year floodplain is defined as either:

a. The 100-year floodplain downstream of the emergency spillway assuming the dam is full to the elevation of the emergency spillway at the beginning of the 100-year storm and the 100-year storm is routed through the dam and out the emergency spillway,

b. Or the path that the basin's 100-year floodplain would form through the downstream development if the dam were removed by the owner.

4.5.5 Reliance on Embankments - Amended

Change:

"The detention of floodwaters behind embankments created by railroads, highways or roadways resulting from hydraulically undersized culverts or bridges should not be utilized by the drainage engineer for flood peak mitigation when determining the downstream flood peaks for channel capacity purposes unless such detention has been covered by a binding agreement approved by the District."

To:

"The detention of floodwaters behind embankments created by railroads, highways or roadways resulting from hydraulically undersized culverts or bridges should not be utilized by the drainage engineer for flood peak mitigation when determining the downstream flood peaks for channel capacity purposes unless such detention has been covered by a binding agreement approved by the Town.

Historical development within the Town limits includes mining, rail, and associated infrastructure subsequently repurposed in part or in full for private and public uses. Applicants should carefully review existing topographic features to ensure stability of embankments, fill, slopes, and other surface and sub-surface features."

5.0 TECHNICAL CRITERIA

5.1 Design Criteria - Amended

Change:

"Storm drainage planning and design should adhere to the criteria developed and presented in this Manual maintained by the District."

To:

"Storm drainage planning and design should adhere to the criteria developed and presented in this Manual maintained by the Town."

5.1.1 Design Criteria - Amended

Change:

"The design criteria presented herein represent current good engineering practice, and their use in the Denver region is recommended. The criteria are not intended to be an ironclad set of rules that the planner and designer must follow; they are intended to establish guidelines, standards and methods for sound planning and design."

To:

"The design criteria presented herein represent current good engineering practice, and their use in the Town of Lyons is recommended. The criteria are not intended to be an ironclad set of rules that the planner, engineer, and designer must follow; they are intended to establish guidelines, standards and methods for sound planning and design. The planner, engineer,

designer, and owner should carefully coordinate with Town staff to collect the best available data for the watersheds affecting the subject property."

5.1.2 Criteria Updating - Accepted

5.1.3 Use of Criteria - Accepted

5.2 Initial and Major Drainage - Accepted

5.2.1 Design Storm Return Periods - Amended

Delete second paragraph

5.2.2 Initial Storm Provisions - Amended

Change:

"The initial storm drainage system, capable of safely handling 2- to 10-year floods depending on local criteria, is necessary to reduce the frequency of street flooding and maintenance costs, to provide protection against regularly recurring damage from storm runoff, to help create an orderly urban system, and to provide convenience to urban residents."

To:

"The initial storm drainage system, capable of safely handling 2-year floods, is necessary to reduce the frequency of street flooding and maintenance costs, to provide protection against regularly recurring damage from storm runoff, to help create an orderly urban system, and to provide convenience to urban residents. Considerations shall be made to ensure downstream facilities are sized to accept flows associated with any new development."

5.2.3 Major Storm Provisions - Accepted

5.2.4 Critical Facilities - Accepted

5.2.5 Major Drainage Channels - Accepted

5.2.6 Tailwater - Accepted

5.3 Runoff Computation - Accepted

5.3.1 Accuracy - Accepted

5.4 Streets - Accepted

5.4.1 Use of Streets - Amended

Change:

"Bubblers (inverted siphons which convey flows beneath roadways) are not encouraged in the Denver region because of possible plugging with sediment and difficulty in maintaining them."

To:

Bubblers (inverted siphons which convey flows beneath roadways) are not encouraged in Lyons because of possible plugging with sediment and difficulty in maintaining them."

Add:

"Street conveyance in portions of the Town is an important means of stormwater conveyance due to limitations of excavation for pipe systems in the rock subgrade present in the majority of the northern side of the St. Vrain."

5.5 Irrigation Ditches- Amended

Add:

Lyons does not allow the discharge of stormwater runoff from developed areas into irrigation ditches and facilities except as required by water rights or where such discharges are in conformance with approved Master Drainage plans. Further, wherever new development will alter patterns of drainage into irrigation ditches by increasing flow rates or volumes, or will change the historic concentration points of runoff, the Town shall require each new development to obtain written consent of the appropriate ditch company before approving the drainage design and development.

Where irrigation and stormwater conveyance intersect, the Town will recommend gravity flow for the stormwater system to prevail and siphon, pump, or other forced flow regimes be reserved for irrigation flows. Irrigation systems typically have a routine maintenance cycle built around seasonal flow patterns unlike perpetual flows within Town storm sewer systems."

5.5.1 Use of Ditches- Amended

Change:

"Land planners downhill from a ditch should plan for pre-ditch drainage conditions as well as continued ditch seepage."

To:

"Land planners and engineers with a proposed development downhill from a ditch shall plan for pre-ditch drainage conditions as well as continued ditch seepage.

Add:

For new development, it shall be the policy of Lyons to prohibit undetained discharges to roadside ditches located in the Town right-of-way. In the event a proposed development wishes to design stormwater discharge to a Town right-of-way, the developer, at the request of the Town, shall have the requirement to design and construct drainage improvements to the right-of-way at the developers' own expense. Such improvements shall include, but not be limited to: detention ponds, armored channels, culverts, level spreaders, and other drainage facilities. Cost-sharing of such needed improvements may be borne by adjacent, upstream, or downstream developments, such cost sharing to be negotiated by the developer. The Town of Lyons will require written agreements and construction bonding of such offsite drainage improvements.

5.5.2 Ditch Perpetuation - Accepted

5.5.3 Conformance With Master Plan - Accepted

Change:

"Use of irrigation ditches for collection and transport of either initial or major storm runoff should be prohibited unless specifically provided in a District's master plan or approved by the District and the ditch owner."

To:

"Use of irrigation ditches for collection and transport of either initial or major storm runoff should be prohibited unless specifically provided in the Town's master plan or approved in writing by the Town and the ditch owner."

5.6 Detention and Retention Facilities Maintenance - Amended

Change:

"The significant cost of handling stormwater runoff, coupled with the social benefits to be derived from proper storm drainage facilities, points towards the use of detention and retention basins for storage of stormwater runoff in the Denver region. Maintenance provisions must be arranged. Maintenance of detention or retention facilities includes the removal of debris, excessive vegetation from the embankment, and sediment. Without maintenance, a detention/retention facility will become an unsightly social liability and eventually become ineffective."

To:

"The significant cost of handling stormwater runoff, coupled with the social benefits to be derived from proper storm drainage facilities, points towards the use of detention basins for storage of stormwater runoff in the Town. Maintenance provisions must be arranged, documented, and reviewed annually. Maintenance of detention facilities includes the removal of debris, trimming excessive vegetation from the embankment, sediment removal, and other procedures set forth by Town Maintenance personnel and engineering staff. Without maintenance, a detention facility will become an unsightly social liability, eventually become ineffective, and ultimately could become a threat to public health and safety."

5.6.1 Water Quality – Accepted

Add:

"Colorado House Bill 1005, provides that rain barrels can only be installed at single-family households and multi-family households with four or fewer units. A maximum of two rain barrels can be used at each household and the combined storage of the two rain barrels cannot exceed 110 gallons. Rain barrels can only be used to capture rainwater from rooftop downspouts and the captured rainwater must be used to water outdoor lawns, plants and/or gardens on the same property from which the rainwater was captured. Rain barrel water cannot be used for

drinking or other indoor water uses. The capture and use of rainwater using rain barrels does not constitute a water right.

The Town will consider drainage plans that utilize rain barrels to offset water quality and detention requirements. In no circumstance will rain barrels completely eliminate other water quality or detention requirements."

6.0 FLOODPLAIN MANAGEMENT

6.1 Purpose - Amended

Delete:

"Various governmental agencies within the Denver region should initiate floodplain management programs."

6.2 Goals - Amended

Change:

"To reduce the vulnerability of Denver region residents to the danger and damage of floods."

To:

To reduce the vulnerability of the Town's residents to the danger and damage of floods.

6.3 National Flood Insurance Program- Accepted

6.3.1 Participation - Accepted

6.3.2 New Development - Amended

If a CLOMR/LOMR submittal is needed with a development application, Lyons shall follow the requirements of the floodplain ordinance.

The Town of Lyons reserves the right to outsource engineering review of all CLOMR and LOMR submittals received with a development application. The Developers shall reimburse the Lyons for all outsourced engineering review costs. Upon FEMA approval of a CLOMR or LOMR, payment of all outsourced engineering review costs is due and payable to Lyons. It is possible for developers to contract directly with one of the Town's outsourced Consultant(s) for the preparation of CLOMR's and LOMR's, if they so desire. However, the Town maintains the right to in in-house or outsourced independent review of the application before providing Town concurrence."

6.4 Floodplain Management - Accepted

6.5 Floodplain Filling- Accepted

6.6 New Development - Accepted

6.7 Strategies and Tools - Accepted

6.7.1 Exposure to Floods - Accepted

6.7.2 Development Policies - Accepted

6.7.3 Preparedness - Accepted

6.7.4 Flood Proofing - Accepted

6.7.5 Flood Forecasting - Accepted

6.7.6 Flood Modification - Accepted

6.7.7 Impact of Modification - Accepted

7.0 IMPLEMENTATION

7.1 Adoption of Drainage Master Plans – Amended

Change:

"This *Manual* and master plans should be adopted and used by all governmental agencies operating within the District."

To:

This Manual and masterplans should be adopted and used by all parties operating within the Town.

7.1.1 Manual Potential - Accepted

7.2 Governmental Operations - Accepted

7.3 Amendments - Amended

Change:

"Problems in urban drainage administration encountered by any governmental agency should be reviewed by the District to determine if equity or public interests indicate a need for drainage policy, practice, or procedural amendments. The District should continually review the needs of the Denver region in regard to urban runoff criteria and should recommend changes as necessary to this *Manual*."

To:

Problems in urban drainage administration encountered by anyone should be reviewed by the Town to determine if equity or public interests indicate a need for drainage policy, practice, or procedural

amendments. The Town should continually review the needs of the town in regard to urban runoff criteria and should recommend changes as necessary to this *Manual*.

7.4 Financing - Accepted

7.4.1 Drainage Costs - Accepted

7.5 Drainage Improvements - Amended

Add:

The policy of Lyons regarding the design and construction of improvements within the Master Drainage Plan shall be set forth below:

a. Lyons shall identify needed design and construction of improvements as set forth in adopted Master Drainage Plans for existing and future growth areas.
b. The drainage systems for future development and redevelopment shall be designed and constructed by the Developer(s).
c. The Developers shall be responsible for design and construction of temporary or interim storm drainage systems required due to the lack of adequate storm drainage facilities downstream of new development.
d. The Developers may be responsible for design and construction of permanent storm drainage systems required due to the lack of adequate storm drainage facilities downstream of new development.

8.0 REFERENCES - *Accepted*

DRAINAGE LAW - Deleted

1.0 SUMMARY OF CURRENT GENERAL PRINCIPLES OF DRAINAGE AND FLOOD CONTROL LAW - Deleted

1.1 Introduction - Deleted

1.2 Legal Principles - Deleted

2.0 GENERAL PRINCIPLES OF DRAINAGE LAW - Deleted

2.1 Private Liability - Deleted

2.1.1 Common Enemy Rule - Deleted

2.1.2 Civil Law Rule - Deleted

2.1.3 Reasonable Use Rule - Deleted

2.2 Municipal Liability - Deleted

2.2.1 Planning Drainage Improvements - Deleted

2.2.2 Construction, Maintenance, and Repair of Drainage Improvements - Deleted

2.2.3 Summary - Deleted

2.3 Municipal Liability for Acts of Others - Deleted

2.3.1 Acts or Omissions of Municipal Officers, Agents, or Employees - Deleted

2.3.2 Municipal Liability for Acts of Developers - Deleted

2.4 Personal Liability of Municipal Officers, Agents, and Employees - Deleted

3.0 DRAINAGE IMPROVEMENTS BY A LOCAL GOVERNMENT - Deleted

3.1 Constitutional Power - Deleted

3.2 Statutory Power - Deleted

3.2.1 Statutes—Municipalities - Deleted

3.2.1.1 Municipal Powers—Public Property and Improvements - Deleted

3.2.1.2 Public Improvements—Special Improvement Districts in Municipalities - Deleted

3.2.1.3 Public Improvements—Improvement Districts in Municipalities - Deleted

3.2.1.4 Sewer and Water Systems—Municipalities - Deleted

3.2.2 Statutes—County - Deleted

3.2.2.1 Public Improvements—Sewer and Water Systems - Deleted

3.2.2.2 County Public Improvement Districts - Deleted

3.2.2.3 Public Improvements—Local Improvement Districts—Counties - Deleted

3.2.2.4 Flood Control—Control of Stream Flow - Deleted

3.2.2.5 Conservancy Law—Flood Control - Deleted

3.2.2.6 Drainage Districts - Deleted

3.2.3 Statutes—State - Deleted

3.2.3.1 Colorado Land Use Act - Deleted

3.2.3.2 Drainage of State Lands - Deleted

3.2.3.3 Water Conservation Board of Colorado - Deleted

3.2.3.4 State Canals and Reservoirs - Deleted

3.2.3.5 Regulatory Impairment of Property Rights - Deleted

3.2.3.6 Intergovernmental Relationships - Deleted

3.2.4 Urban Drainage and Flood Control Act - Deleted

4.0 FINANCING DRAINAGE IMPROVEMENTS - Deleted

4.1 Capital Improvement - Deleted

4.2 Local Improvement - Deleted

4.3 Special Improvement - Deleted

4.4 Service Charge - Deleted

4.5 Developer's Cost - Deleted

4.6 The Taxpayers Bill of Rights, Article X, Section 20, Colorado Constitution - Deleted

4.7 Water Activities—Enterprise Statute 37-45.1-101 C.R.S - Deleted

5.0 FLOODPLAIN MANAGEMENT - Deleted

5.1 Floodplain Regulations - Deleted

5.1.1 Constitutional Considerations - Deleted

5.1.2 Statutory Grants of Power - Deleted

5.1.3 Court Review of Floodplain Regulations - Deleted

5.1.3.1 Restriction of Uses - Deleted

5.1.3.2 Health Regulations - Deleted

5.1.3.3 Determination of Boundaries - Deleted

5.2 Flood Insurance - Deleted

5.3 Flood Warning Systems and Notification - Deleted

6.0 SPECIAL MATTERS - Deleted

6.1 Irrigation Ditches - Deleted

6.2 Dams and Detention Facilities - Deleted

6.3 Water Quality - Deleted

6.4 Professional Responsibility - Deleted

7.0 CONCLUSION - Deleted

PLANNING

1.0 THE DRAINAGE SUBSYSTEM - Accepted

1.1 Planning - Accepted

1.2 Planning Philosophy - Accepted

1.3 Drainage Management Measures - Accepted

1.4 Water Quality - Accepted

2.0 EARLY PLANNING ADVANTAGES - Accepted

2.1 Advantages - Accepted

2.2 New Development - Accepted

2.3 Get the Facts - Accepted

2.4 Regulatory Considerations - Accepted

3.0 CONSIDER DRAINAGE BENEFITS - Accepted

3.1 Benefits - Accepted

4.0 MASTER PLANNING

4.1 Master Plan - Accepted

4.2 Uniformity - Accepted

5.0 PLANNING FOR THE FLOODPLAIN

5.1 Floodplains - Accepted

5.2 Concept of Floodplain Regulation - Accepted

5.3 Tools - Accepted

6.0 PLANNING FOR MAJOR DRAINAGE

6.1 Major Drainage - Accepted

6.2 Initial Route Considerations - Accepted

6.3 The Master Plan - Accepted

6.4 Open Channels - Accepted

7.0 PLANNING FOR INITIAL DRAINAGE

7.1 Initial Drainage - Amended

Change:

"The initial storm has been defined for the area served by the District to have a return frequency ranging from once in 2 years to once in 10 years."

To:

The initial storm has been defined for Lyons to have a return frequency once in 2 years.

7.2 Streets - Accepted

8.0 PLANNING FOR STORAGE

8.1 Upstream Storage - Accepted

8.2 Downstream Storage - Accepted

8.3 Channel Storage -Accepted

8.4 Other Benefits-Accepted

9.0 PLANNING FOR STORM SEWERS

9.1 Storm Sewers -Amended

Change:

"It is what directly contributes to the orderly growth of a community by handling the storm runoff expected to occur once every two to ten years."

To:

It is what directly contributes to the orderly growth of a community by handling the storm runoff expected to occur once every two years.

9.2 Function of Storm Sewers -Accepted

9.3 Layout Planning-Accepted

9.4 System Sizing –Amended

Change:

"The suggested design return periods to be used by local jurisdictions in the Denver region for storm sewer design for all land uses is 2- to 10-years."

To:

The design return period to be used for storm sewer design in Lyons is the 2-year storm for all land uses. Storm sewers passing flow under Town roads shall have a minimum design capacity for the 10-year storm and a minimum diameter of 18 inches or equivalent open area. System sizing design shall adhere to Boulder County street inundation criteria.

RAINFALL

1.0 OVERVIEW - Amended

Rainfall values were determined using NOAA ATLAS 2 Volume III. These values were used into UDFCD's UD-Rain v.1.01 spreadsheet to convert these values from the 6-hr and 24-hr storms present in the NOAA ATLAS to more frequently used storm durations. Intensity-Duration-Frequency and Depth-Duration-Frequency graphs and tables were created using point values from the UD-Rain worksheet. Intensity-Duration-Frequency values can be seen in Table 1 and Figure 1. Depth-Duration-Frequency values can be found in Table 2 and Figure 2.

2.0 RAINFALL DEPTH-DURATION-FREQUENCY

2.1 Rainfall Depth-Duration-Frequency Maps - Deleted

2.2 Rainfall Depths For Durations Between 1- and 6-Hours - Amended

Table 1: Rainfall Depth (in) at Time Duration

Return Period	Rainfall Depth in Inches at Time Duration								
	5-min	*10-min*	*15-min*	*30-min*	*1-hr*	*2-hr*	*3-hr*	*6-hr*	*24-hr*
2-yr	0.27	0.43	0.54	0.62	0.95	1.10	1.22	1.40	1.90
5-yr	0.38	0.61	0.77	0.89	1.35	1.56	1.71	1.95	2.65
10-yr	0.46	0.73	0.92	1.06	1.61	1.85	2.02	2.30	3.05
25-yr	0.55	0.88	1.10	1.28	1.95	2.22	2.43	2.75	3.80
50-yr	0.64	1.02	1.28	1.48	2.26	2.55	2.76	3.10	4.25
100-yr	0.72	1.15	1.45	1.68	2.55	2.84	3.06	3.40	4.85
500-yr	0.90	1.44	1.81	2.09	3.19	3.56	3.83	4.26	6.01

3.0 DESIGN STORM DISTRIBUTION FOR CUHP

3.1 Temporal Distribution

3.2 Adjustment to Rainfall Distribution for Watershed Size - Amended

Due to the size of the Lyons watershed, there is no need for any area adjustment.

4.0 INTENSITY-DURATION CURVES FOR RATIONAL METHOD - Amended

Table 2: Rainfall Intensity (in/hr) at Time Duration

Return Period	Rainfall Intensity in Inches Per Hour at Time Duration								
	5-min	*10-min*	*15-min*	*30-min*	*1-hr*	*2-hr*	*3-hr*	*6-hr*	*24-hr*
2-yr	3.22	2.57	2.16	1.49	0.95	0.59	0.44	0.26	0.09
5-yr	4.58	3.65	3.07	2.12	1.35	0.84	0.62	0.37	0.13
10-yr	5.47	4.37	3.66	2.53	1.61	1.00	0.74	0.44	0.15
25-yr	6.60	5.27	4.42	3.05	1.95	1.21	0.90	0.53	0.18
50-yr	7.66	6.11	5.13	3.55	2.26	1.40	1.04	0.62	0.21
100-yr	8.66	6.91	5.80	4.01	2.55	1.59	1.18	0.70	0.24
500-yr	10.83	8.63	7.25	5.01	3.19	1.98	1.47	0.87	0.30

5.0 BASIS FOR DESIGN STORM DISTRIBUTION - Accepted

6.0 SPREADSHEET DESIGN AIDS - Accepted

7.0 EXAMPLES - Deleted

7.1 Example Computation of Point Rainfall - Deleted

7.2 Example Distribution of Point Rainfall - Deleted

7.3 Example Preparation of Intensity-Duration-Frequency Curve - Deleted

8.0 REFERENCES - Accepted

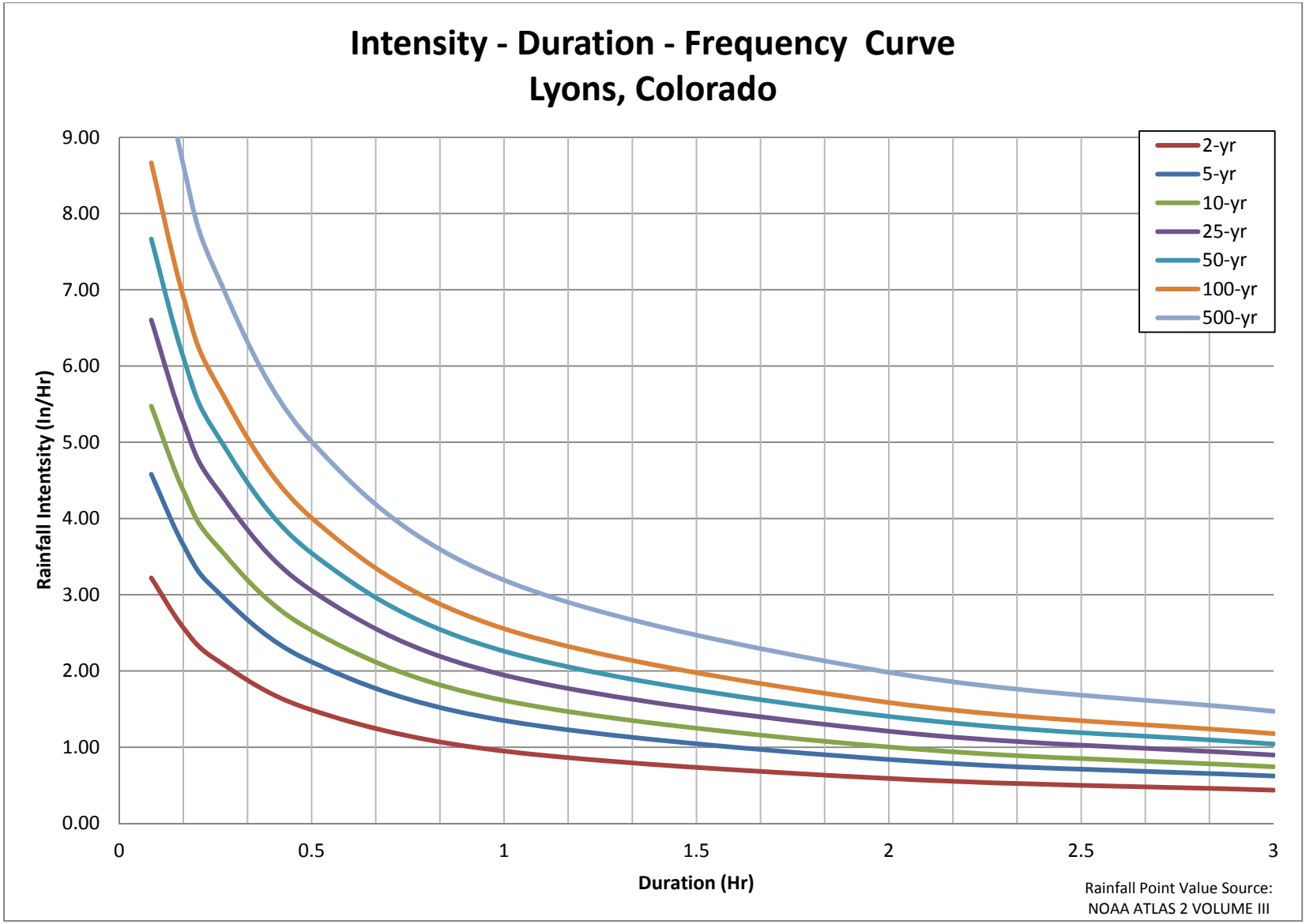

Figure 1: Intensity-Duration-Frequency Curve

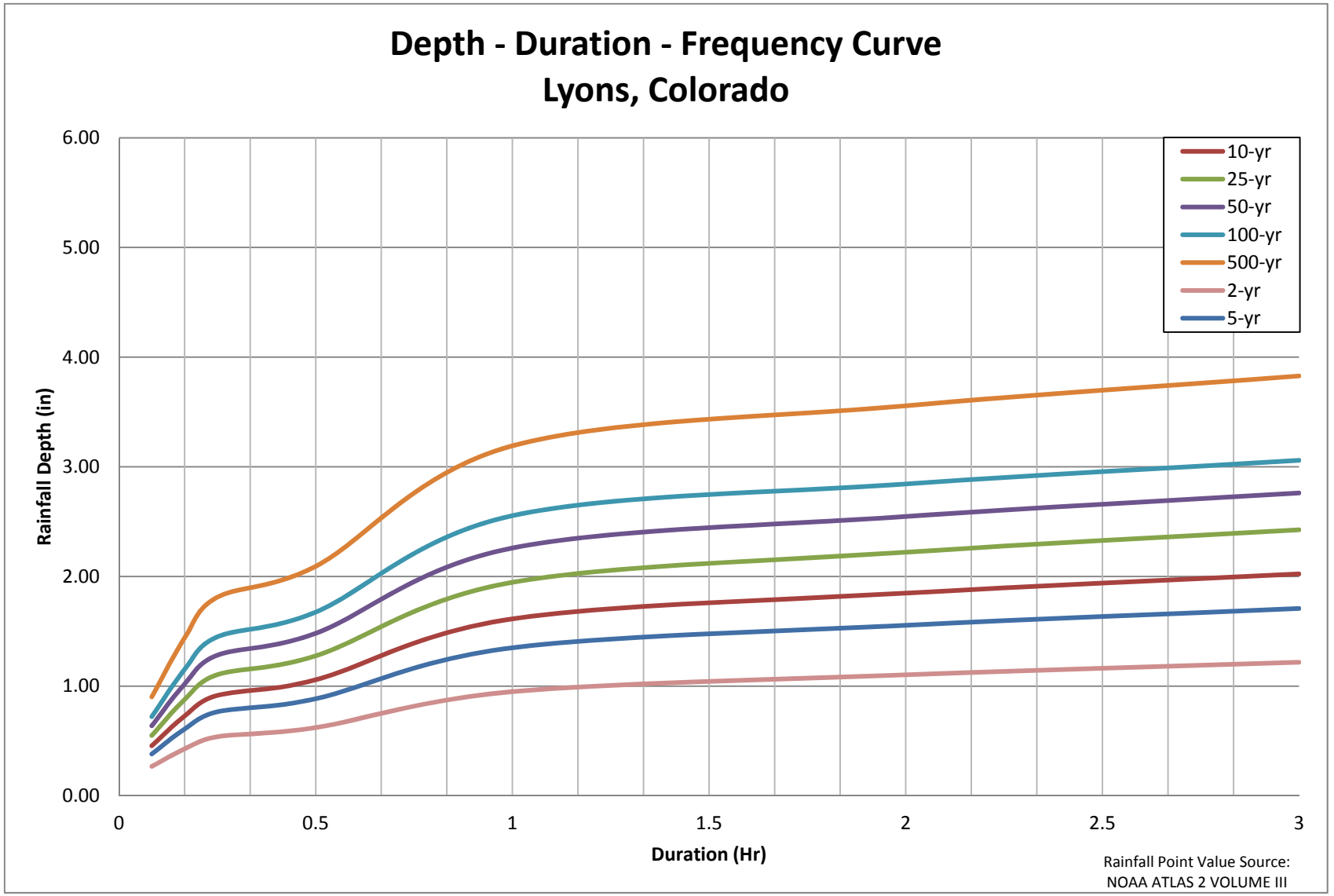

Figure 2: Depth-Duration-Frequency Curve

RUNOFF

1.0 OVERVIEW - Accepted

2.0 RATIONAL METHOD - Accepted

2.1 Rational Formula- Accepted

2.2 Assumptions- Accepted

2.3 Limitations- Accepted

2.4 Time of Concentration - Accepted

2.4.1 Initial Flow Time- Accepted

2.4.2 Overland Travel Time - Accepted

2.4.3 First Design Point Time of Concentration in Urban Catchments- Accepted

2.4.4 Minimum Time of Concentration- Accepted

2.4.5 Common Errors in Calculating Time of Concentration - Accepted

2.5 Intensity- Accepted

2.6 Watershed Imperviousness- Amended

The intensity for a design point should be selected from **Error! Reference source not found.**

2.7 Runoff Coefficient – Accepted

3.0 COLORADO URBAN HYDROGRAPH PROCEDURE- Accepted

3.1 Background- Accepted

3.2 Effective Rainfall for CUHP- Accepted

3.2.1 Pervious-Impervious Area- Accepted

3.2.2 Depression Losses- Accepted

3.2.3 Infiltration- Accepted

3.3 CUHP Parameter Selection- Accepted

3.3.1 Rainfall- Accepted

3.3.2 Catchment Description- Accepted

3.3.3 Catchment Delineation Criteria- Accepted

3.3.3 Combining and Routing Sub-Catchment CUHP Hydrographs- Accepted

4.0 EPA SWMM AND HYDROGRAPH ROUTING- Accepted

4.1 Software Description- Accepted

4.1.1 Surface Flows and Flow Routing Features- Accepted

4.1.2 Flow Routing Method of Choice - Accepted

4.2 Data Preparation for the SWMM Software- Accepted

4.2.1 Step 1—Method of Discretization - Accepted

4.2.2 Step 2—Estimate Coefficients and Functional/Tabular Characteristic of Storage and Outlets- Accepted

4.2.3 Step 3—Preparation of Data for Computer Input - Accepted

5.0 OTHER HYDROLOGIC METHODS - Accepted

5.1 Published Hydrologic Information -Amended

Change:

"The District has prepared hydrologic studies for the majority of the major drainageways within District boundaries. These studies contain information regarding peak flow and runoff volume from the 2-year through 100-year storm events for numerous design points within the watershed. They also contain information regarding watershed and sub-watershed boundaries, soil types, percentage imperviousness, and rainfall. The studies are available at the District library. When published flow values are available from the District for any waterway of interest, these values should be used for design unless there are compelling reasons to modify the published values."

To:

The Town of Lyons has a master plan containing information regarding peak flow and runoff volume from the 2-year through 100-year storm events for numerous design points within the watershed. The report also contains information regarding watershed and sub-watershed boundaries, soil types, percentage imperviousness, and rainfall. The study is available through the Town. These flow values should be used for design unless there are compelling reasons to modify the published values.

5.2 Statistical Methods – Amended

Statistical methods should not be applied to watersheds within Lyons.

STREETS/INLETS/STORM SEWERS

1.0 INTRODUCTION

1.1 Purpose - Accepted

1.2 Urban Stormwater Collection and Conveyance Systems - Accepted

1.3 Components of Urban Stormwater Collection and Conveyance Systems - Accepted

Change:

"Urban stormwater collection and conveyance systems within the District are comprised of three primary components: (1) street gutters and roadside swales, (2) stormwater inlets, and (3) storm sewers (and appurtenances like manholes, junctions, etc.)."

To:

Urban stormwater collection and conveyance systems within the town are comprised of three primary components: (1) street gutters and roadside swales, (2) stormwater inlets, and (3) storm sewers (and appurtenances like manholes, junctions, etc.).

1.4 Minor and Major Storms - Accepted

2.0 STREET DRAINAGE

2.1 Street Function and Classification - Accepted

2.2 Design Considerations - Amended

Change:

"Based on these considerations, the District has established encroachment (spread) standards for the minor storm event. These standards were given in the POLICY chapter and are repeated in Table ST-2 for convenience."

To:

Based on these considerations, the town has established encroachment (spread) standards for the minor storm event. These standards were given in the POLICY chapter of the USDCM and are repeated in Table ST-2 for convenience.

2.3 Hydraulic Evaluation – Accepted

2.3.1 Curb and Gutter - Accepted

2.3.1.1 Gutters With Uniform Cross Slopes (i.e., Where Gutter Cross Slope = Street Cross Slope) – Accepted

2.3.1.2 Gutters With Composite Cross Slopes (i.e., Where Gutter Cross Slope ≠ Street Cross Slope) – Accepted

2.3.1.3 Allowable Gutter Hydraulic Capacity - Amended

Change:

"There are two sets of reduction factors developed for Denver metropolitan areas (Guo 2000b)."

To:

There are two sets of reduction factors developed for Denver metropolitan areas (Guo 2000b) and shall be utilized for the town.

2.4 Major Storm Hydraulics

2.4.1 Purpose and Objectives - Accepted

2.4.2 Street Hydraulic Capacity - Accepted

3.0 INLETS

3.1 Inlet Functions, Types and Appropriate Applications - Accepted

Add:

The standard inlets permitted for use in the town streets are:

Table 3: Permitted Inlet Type Use

INLET TYPE	PERMITTED USE
Curb Opening Inlet Type R	All street types with 6" vertical curb
Grated Inlet Type C	All streets with a roadside ditch or swale
Grated Inlet Type 13	Alleys or private drives with a valley gutter
Combination Inlet Type 13	All street types with 6" vertical curb

3.2 Design Considerations – Accepted

3.3 Hydraulic Evaluation – Accepted

3.3.1 Grate Inlets (On a Continuous Grade) – Accepted

3.3.2 Curb-Opening Inlets (On a Continuous Grade) – Accepted

3.3.3 Combination Inlets (On a Continuous Grade) – Accepted

3.3.4 Slotted Inlets (On a Continuous Grade) – Accepted

3.3.5 Inlets Located in Sumps - Accepted

3.3.6 Inlet Clogging - Accepted

3.3.6 Inlet Clogging - Amended

Add:

To account for effects which decrease the capacity of the various types of inlets, such as debris plugging, pavement overlaying and variations in design assumptions, the theoretical capacity calculated for the inlets is to be reduced by the factors presented below for the standard inlets permitted for use in the town.

Table 4: Allowable Inlet Capacity

ALLOWABLE INLET CAPACITY		
CONDITION	INLET TYPE	PERCENT OF THEORETICAL CAPACITY ALLOWED
Sump or Continuous Grade	CDOT Type R	
	5’ length	88
	10’ length	92
	15’ length	95
Continuous Grade	Combination Type 13	66
Sump	Grate Type C	50
Sump	Grate Type 13	50
Sump	Combination Type 13	65

3.4 Inlet Location and Spacing on Continuous Grades

3.4.1 Introduction - Accepted

3.4.2 Design Considerations - Amended

Delete:

“Table ST-2 lists pavement encroachment standards for minor storms in the Denver metropolitan area.”

3.4.3 Design Procedure - Accepted

4.0 STORM SEWERS

4.1 Introduction - Accepted

4.2 Design Process, Considerations, and Constraints - Amended

Change:

"Pipes sizes smaller than 15 inches are not recommended for storm sewers."

To:

The minimum size storm sewer pipe within a Public Right-of-Way or Public Drainage Easement shall be 15 inches in diameter or equivalent open area.

4.3 Storm Sewer Hydrology

4.3.1 Peak Runoff Prediction - Accepted

4.4 Storm Sewer Hydraulics (Gravity Flow in Circular Conduits)

4.4.1 Flow Equations and Storm Sewer Sizing - Amended

Add:

"The Manning's roughness coefficient "n" for all storm sewer pipe capacity Boulder County calculations shall be 0.013 regardless of pipe material (i.e. Concrete, PVC, or HDPE) with the exception of corrugated metal pipes which shall have a coefficient of 0.025."

4.4.2 Energy Grade Line and Head Losses - Accepted

4.4.2.1 Losses at the Downstream Manhole—Section 1 to Section 2 - Accepted

4.4.2.2 Losses in the Pipe, Section 2 to Section 3. - Accepted

4.4.2.3 Losses at the Upstream Manhole, Section 3 to Section 4 - Accepted

4.4.2.4 Juncture and Bend Losses at the Upstream Manhole, Section 4 to Section 1 - Accepted

4.4.2.5 Transitions - Accepted

4.4.2.6 Curved Sewers - Accepted

4.4.2.7 Losses at Storm Sewer Exit - Accepted

4.5 Hydraulic and Energy Grade Line Calculations - Amended

Add:

"The hydraulic grade line and energy grade line shall be calculated for each storm sewer system and included in the Final Drainage Report. Each storm sewer system shall be profiled on the Final Construction Drawings and shall include the design flow hydraulic

grade line (HGL). The energy grade line (EGL) for the design flow shall be at least 6 inches below the final finished elevation of the manhole rims and inlet flow lines."

5.0 SPREADSHEETS - Accepted

6.0 EXAMPLES - Accepted

6.1 Example—Triangular Gutter Capacity- Accepted

6.2 Example—Composite Gutter Capacity - Accepted

6.3 Example—Composite Gutter Spread - Accepted

6.4 Example—V-Shaped Swale Capacity - Accepted

6.5 Example—V-Shaped Swale Design - Accepted

6.6 Example—Major Storm Street Capacity- Accepted

6.7 Example—Grate Inlet Capacity - Accepted

6.8 Example—Curb-Opening Inlet Capacity - Accepted

6.9 Example—Curb-Opening Inlet Capacity - Accepted

6.10 Example—Combination Inlet Capacity - Accepted

6.11 Example—Curb-Opening Inlet in a Sump Condition - Accepted

6.12 Example—Storm Sewer Hydraulics (Akan and Houghtalen 2002) - Accepted

6.13 Example—Storm Sewer Hydrology - Accepted

7.0 REFERENCES

MAJOR DRAINAGE

1.0 INTRODUCTION

1.1 General – Accepted

1.2 Types of Major Drainage Channels – Accepted

1.3 Overview of Chapter – Accepted

1.4 Issues in Major Drainage Planning and Engineering – Accepted

1.5 Fluvial Geomorphology – Accepted

1.5.1 Stream Channel Characterization – Accepted

1.5.2 Effects of Urbanization on Stream Channels – Accepted

1.5.3 Stable Channel Balance – Accepted

1.5.4 References for Additional Information – Accepted

2.0 PLANNING

2.1 General – Accepted

2.2 Impacts of Urbanization and Associated Effects – Accepted

2.3 Special Considerations for Semi-Arid Climates – Accepted

2.4 Route Considerations – Accepted

2.4.1 Present Flow Path – Accepted

2.4.2 Historic Flow Path – Accepted

2.4.3 Permitting and Regulations – Accepted

2.4.4 Public Safety – Accepted

2.4.5 Public Acceptance – Accepted

2.4.6 Alternate Routes – Accepted

2.4.7 Maintenance – Accepted

2.4.8 Route Cost – Accepted s

2.4.9 Recreational Use Potential – Accepted

2.4.10 Environmental Considerations – Accepted

2.4.11 Presentation of Choice – Accepted

2.4.12 Underground Conduits – Accepted

2.4.13 Two-Stage Channels – Accepted

2.5 Layout – Accepted

2.5.1 Working Map – Accepted

2.5.2 Preliminary Plan and Profile – Accepted

2.6 Master Planning or Preliminary Design – Accepted

2.6.1 Criteria for Final Hydrology – Accepted

2.7 The Master Plan – Accepted

2.7.1 Report – Amended

The previous section, 4.1 Master Plan - Accepted

, along with Preliminary Drainage Report and Final Drainage Report outlined the requirements for drainage studies within the town.

2.7.2 Drawings – Amended

See Section 2.7.1 for links to drawing requirements for drainage studies within the town.

3.0 OPEN CHANNEL DESIGN PRINCIPLES

3.1 General Open Channel Flow Hydraulics – Accepted

3.1.1 Types of Flow in Open Channels – Accepted

3.1.2 Roughness Coefficients – Accepted

3.1.3 Flow Regime – Accepted

3.1.3.1 Critical Flow – Accepted

3.1.3.2 Subcritical Flow – Accepted

3.1.3.3 Supercritical Flow – Amended

Change:

“In the Denver region, all channels carrying supercritical flow shall be lined with continuously reinforced concrete linings, both longitudinally and laterally.”

To:

"In Lyons, all channels carrying supercritical flow shall be lined with continuously reinforced concrete linings, both longitudinally and laterally."

3.2 Preliminary Design Criteria

3.2.1 Design Velocity – Accepted

3.2.2 Design Depths – Accepted

3.2.3 Design Slopes

3.2.3.1 Channel Slope – Accepted

3.2.3.2 Side Slopes - Amended

Add following Paragraph 1:

"For constructed or natural channels with side slopes steeper than 2:1, appropriate construction setbacks not less than 5 feet laterally from the channel edge may be required to allow potential future channel meandering. Rock excavated channels may be submitted for approval of smaller setbacks based on consistency, erosion potential, and stability of the rock subgrade. Access for maintenance may require easement."

3.2.4 Curvature and Transitions – Accepted

3.2.5 Design Discharge Freeboard – Accepted

3.2.6 Erosion Control – Accepted

3.2.7 Summary of Preliminary Design Guidance – Amended

Add to Table MD-2:

"Grass lined open channels conveying < 50 cfs may reduce the minimum 1.0 foot freeboard requirement to the freeboard required to conveying 1.33 times the 100-year design flow. The reduced freeboard may only occur if a 1.0-foot minimum freeboard is not physically or reasonably possible and a variance request is submitted."

3.2.8 Maintenance Eligibility – Amended

Delete first paragraph

Add:

Lyons will only maintain eligible major drainage ways by special agreement. The requirements below must be satisfied as of (adoption date) for a major drainage channel to be eligible for maintenance. Note that the town's "Maintenance Eligibility Guidelines" may change with time.

3.2.8.1 Natural Channels (Open Floodplain Design) – Accepted

3.2.8.2 Open Floodway Design (Natural Channel With Floodplain Encroachment) – Accepted

3.2.8.3 Grass-Lined Channel Design – Amended

Change:

"The design for a grass-lined channel must meet the following criteria to be eligible for District maintenance:"

To:

The design for a grass-lined channel must meet the following criteria to be eligible for maintenance:

3.3 Choice of Channel Type and Alignment

3.3.1 Types of Channels for Major Drainageways – Accepted

3.3.2 Factors to Consider in Selection of Channel Type and Alignment – Accepted

3.3.3 Environmental Permitting Issue – Accepted

3.3.4 Maintenance – Amended

Change:

"A maintenance access road with a minimum passage width of 12 feet shall be provided along the entire length of all major drainageways. The local government may require the road to be surfaced with 6 inches of Class 2 roadbase or a 5-inch-thick concrete slab."

To:

The town and the design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

3.4 Design Flows – *Accepted*

3.5 Choice of Channel Lining – *Accepted*

4.0 OPEN-CHANNEL DESIGN CRITERIA

4.1 Grass-Lined Channels – *Accepted*

4.1.1 Design Criteria – *Accepted*

4.1.1.1 Design Velocity and Froude number – *Accepted*

4.1.1.2 Design Depths – *Accepted*

4.1.1.3 Design Slopes – *Accepted*

4.1.1.4 Curvature – *Accepted*

4.1.1.5 Design Discharge Freeboard – *Accepted*

4.1.2 Grass and Vegetation Selection and Use – *Accepted*

4.1.3 Channel Cross Sections – *Accepted*

4.1.3.1 Side Slopes – *Accepted*

4.1.3.2 Depth – *Accepted*

4.1.3.3 Bottom Width – *Accepted*

4.1.3.4 Trickle and Low-Flow Channels – *Accepted*

4.1.3.5 Outfalls Into Channel – *Accepted*

4.1.4 Roughness Coefficients – *Accepted*

4.1.5 Trickle and Low-Flow Channels – *Amended*

Add:

“Under drain pipes shall not be used in lieu of trickle channel within the town but will be considered by the town on a case-by-case basis. Any under drain pipe that is installed will require clean outs not less than every 50 feet, pipe bedding, and headwalls or manholes at the outlet.

4.1.6 Erosion Control – Accepted

4.1.6.1 Erosion at Bends – Accepted

4.1.6.2 Riprap Lining of Grass-lined Channels – Accepted

4.1.7 Water Surface Profile – Accepted

4.1.8 Maintenance – Amended

Change:

"A stable maintenance access road with a minimum passage width of 12 feet shall be provided along the entire length of all major drainageways. The local government may require the road to have an all-weather surface such as a 5-inch-thick concrete pavement."

To:

The town and the design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

4.1.9 Calculation Tool – Accepted

4.1.10 D e s i g n Submittal Checklist – Accepted

4.2 Composite Channels – Accepted

4.2.1 Design Criteria – Accepted

4.2.2 Design Procedure – Accepted

4.2.3 Life Expectancy and Maintenance – Amended

Change:

"A maintenance access road with a minimum passage width of 12 feet shall be provided along the entire length of all major drainageways. The local government may require the road to be surfaced with 6 inches of Class 2 roadbase or a 5-inch-thick concrete slab."

To:

The town and design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

4.2.4 Calculation Example for Wetland Bottom Channel – Accepted

4.2.5 Design Submittal Checklist – Accepted

4.3 Concrete-Lined Channels – Accepted

4.3.1 Design Criteria

4.3.1.1 Design Velocity and Froude Number – Accepted

4.3.1.2 Design Depths – Accepted

4.3.1.3 Curvature – Accepted

4.3.1.4 Design Discharge Freeboard – Accepted

4.3.2 Concrete Lining Specifications

4.3.2.1 Concrete Lining Section – Accepted

4.3.2.2 Concrete Joints – Accepted

4.3.2.3 Concrete Finish – Accepted

4.3.2.4 Underdrain – Accepted

4.3.3 Channel Cross Section – Accepted

4.3.3.1 Side Slopes – Accepted

4.3.3.2 Depth – Accepted

4.3.3.3 Bottom Width – Accepted

4.3.3.4 Trickle and Low-Flow Channels – Accepted

4.3.3.5 Outfalls Into Channel – Accepted

4.3.4 Safety Requirements – Accepted

4.3.5 Calculation Tools – Accepted

4.3.6 Maintenance – Accepted

4.3.7 Design Submittal Checklist – Accepted

4.4 Riprap-Lined Channels – Accepted

4.4.1 Types of Riprap – Accepted

4.4.1.1 Ordinary and Soil Riprap – Accepted

4.4.1.2 Grouted Boulders – Accepted

4.4.1.3 Wire-Enclosed Rock (Gabions) – Amended

Change:

“For these reasons, the District discourages the use of wire-enclosed rock.”

To:

For these reasons, the town discourages the use of wire-enclosed rock.

4.4.2 Design Criteria - Accepted

4.4.2.1 Design Velocity – Accepted

4.4.2.2 Design Depths – Accepted

4.4.2.3 Riprap Sizing – Accepted

4.4.2.4 Riprap Toes – Accepted

4.4.2.5 Curves and Bends – Accepted

4.4.2.6 Transitions – Accepted

4.4.2.7 Design Discharge Freeboard – Accepted

4.4.3 Roughness Coefficient – Accepted

4.4.4 Bedding Requirements – Accepted

4.4.4.1 Granular Bedding – Accepted

4.4.4.2 Filter Fabric – Accepted

4.4.5 Channel Cross Section

4.4.5.1 Side Slopes – Accepted

4.4.5.2 Depth – Accepted

4.4.5.3 Bottom Width – Accepted

4.4.5.4 Outfalls Into Channel – Accepted

4.4.6 Erosion Control – Accepted

4.4.7 Maintenance – Amended

Change:

"A maintenance access road with a minimum passage width of 12 feet shall be provided along the entire length of all major drainageways. The local government may require the road to have an all-weather surface such as 5-inch-thick concrete pavement."

To:

The town and design engineer shall work together to provide access to all major drainageways as determined appropriate at the time of preliminary and final design.

4.4.8 Calculation Example – Accepted

4.4.9 Design Submittal Checklist – Accepted

4.5 Bioengineered Channels – Amended

Change:

"The District advocates the integration of bioengineering techniques into drainage planning, design, and construction when the use of such channels is consistent with the District's policies concerning flow carrying capacity, stability, maintenance, and enhancement of the urban environment and wildlife habitat."

To:

The town advocates the integration of bioengineering techniques into drainage planning, design, and construction when the use of such channels is consistent with the town's policies concerning flow carrying capacity, stability, maintenance, and enhancement of the urban environment and wildlife habitat.

4.5.1 Components – Accepted

4.5.2 Applications – Accepted

4.5.3 Bioengineering Resources – Amended

Change:

"The purpose of this section is to provide the designer with an overview of bioengineering and basic guidelines for the use of bioengineered channels on major drainage projects within the District."

To:

The purpose of this section is to provide the designer with an overview of bioengineering and basic guidelines for the use of bioengineered channels on major drainage projects within the town.

4.5.4 Characteristics of Bioengineered Channels – Amended

Change (1):

"In the absence of grade control structures, especially in the semi-arid climate of the Denver area, purely bioengineered channels will normally be subject to bed and bank erosion, channel instability, and degradation."

To:

In the absence of grade control structures, especially in the semi-arid, high altitude climate of the Lyons area, purely bioengineered channels will normally be subject to bed and bank erosion, channel instability, seasonal variations, and degradation.

Change (2):

"In addition to grade controls, most bioengineered channels require some structural methods to assist the vegetation with maintaining channel stability."

To:

In addition to grade controls, bioengineered channels will require some structural methods to assist the vegetation with maintaining channel stability.

4.5.5 Advantages of Bioengineered Channels – Amended

Change:

"Public reaction to bioengineered channels is generally favorable, not only in metropolitan Denver, but also regionally and nationally."

To:

Public reaction to bioengineered channels is generally favorable, not only in northern Colorado, but also regionally and nationally.

Change (6):

“Create a living system that may strengthen over time.”

To:

Create a living system that will strengthen over time.

Add (8):

“8. Are less costly to maintain”

4.5.6 Technical Constraints – Amended

Change:

“The following constraints are associated with bioengineered channels:”

To:

The following constraints may be associated with bioengineered channels:

Change (2):

“The semi-arid conditions that characterize Denver can be at odds with the need for an adequate water supply for maintaining the vegetation”

To:

The semi-arid conditions that characterize Lyons can be at odds with the need for an adequate water supply for maintaining the vegetation

Change (3):

“A basic design criterion within the District is to demonstrate channel stability during the major (100-year) storm, due to public safety and property protection concerns within urban areas.”

To:

A basic design criterion within Lyons is to demonstrate channel stability during the major (100-year) storm, due to public safety and property protection concerns within urban areas.

Delete:

“Large trees can threaten the integrity of structural protection by root invasion, by toppling and damaging the protection works, by toppling and directing flow into an adjacent unprotected bank, or by leaving voids in embankments due to decomposition.”

Change:

“Many of these problems may be avoided through selection of the appropriate type and species of vegetation. Such selections and expert advice must be obtained from qualified individuals in revegetation and bioengineering. Invasion by other species is quite likely over the years the bioengineered channel is in operation.”

To:

Many of these problems may be avoided through selection of the appropriate type and species of vegetation. Such selections and expert advice must be obtained from qualified individuals in

revegetation and bioengineering. Consideration of native plant species can provide additional confidence in the long term sustainability of the natural vegetation. Resources available through the Colorado State University Extension and Colorado Native Plant Society can be useful references during planning, design, and management of a project.

4.5.7 Design Guidelines – Accepted

4.6 Natural Channels

Change:

"Natural waterways in the Denver region are sometimes in the form of steep-banked gulches, which have eroding banks and bottoms."

To:

Natural waterways are sometimes in the form of steep-banked gulches, which have eroding banks and bottoms.

Change:

"In the Denver area, most natural waterways will need drops and/or erosion cutoff check structures to maintain a mild channel slope and to control channel erosion."

To

In Lyons, most natural waterways will need drops and/or erosion cutoff check structures to maintain a mild channel slope and to control channel erosion.

Change (2):

"A water surface profile should be defined in order to identify the 100-year floodplain, to control earthwork, and to build structures in a manner consistent with the District's and local floodplain regulations and ordinances."

To:

A water surface profile should be defined in order to identify the 100-year floodplain, to control earthwork, and to build structures in a manner consistent with the Lyons floodplain regulations and ordinances.

4.7 Retrofitting Open-Channel Drainageways – Accepted

4.7.1 Opportunities for Retrofitting – Accepted

4.7.2 Objectives of Retrofitting – Accepted

4.7.3 Natural and Natural-Like Channel Creation and Restoration – Accepted

5.0 RECTANGULAR CONDUITS

5.1 Hydraulic Design – Accepted

5.1.1 Entrance – Accepted

5.1.2 Internal Pressure – Accepted

5.1.3 Curves and Bends – Accepted

5.1.4 Transitions – Accepted

5.1.5 Air Entrainment – Accepted

5.1.6 Major Inlets – Accepted

5.1.7 Sedimentation – Accepted

5.2 Appurtenances – Accepted

5.2.1 Energy Dissipators – Accepted

5.2.2 Access Manholes – Accepted

5.2.3 Vehicle Access Points – Accepted

5.2.4 Safety – Accepted

5.2.5 Air Venting – Accepted

6.0 LARGE PIPES – Accepted

6.1 Hydraulic Design – Accepted

6.1.1 Entrance – Accepted

6.1.2 Internal Pressure – Accepted

6.1.3 Curves and Bends – Accepted

6.1.4 Transitions – Accepted

6.1.5 Air Entrainment and Venting – Accepted

6.1.6 Major Inlets – Accepted

6.2 Appurtenances – Accepted

6.3 Safety – Accepted

USDCM VOLUME 2

HYDRAULIC STRUCTURES

1.0 USE OF STRUCTURES IN DRAINAGE

1.1 Introduction – Accepted

1.2 Channels Used for Boating – Accepted

1.3 Channel Grade Control Structures – Accepted

1.4 Wetland Channel Grade Control – Accepted

1.5 Conduit Outlet Structures – Accepted

1.6 Bridges – Accepted

1.7 Transitions and Constrictions – Accepted

1.8 Bends and Confluences – Accepted

1.9 Rundowns – Accepted

1.10 Energy Dissipation – Accepted

1.11 Maintenance – Accepted

1.12 Structure Safety and Aesthetics – Accepted

2.0 CHANNEL GRADE CONTROL STRUCTURES (CHECK AND DROP STRUCTURES)

2.1 Planning for the Future – Accepted

2.1.1 Outline of Section – Accepted

2.1.2 Boatable Channels – Deleted

2.1.3 Grass and Wetland Bottom Channels – Accepted

2.1.4 Basic Approach to Drop Structure Design – Accepted

2.2 Drop Selection – Accepted

2.3 Detailed Hydraulic Analysis – Accepted

2.3.1 Introduction – Accepted

2.3.2 Crest and Upstream Hydraulics – Accepted

2.3.3 Water Surface Profile Downstream of the Crest – Accepted

2.3.7.1 Critical Depth Along a Drop Structure. – Accepted

2.3.7.2 Hydraulic Analysis. – Accepted

2.3.7.3 Manning's n for Concrete, Boulders and Grouted Boulders – Accepted

2.3.7.4 Avoid Low Froude Number Jumps in Grass-Lined Channels. – Accepted

2.3.4 Hydraulic Jump Location – Accepted

2.3.5 Jump and Basin Length – Accepted

2.3.6 Seepage Analysis – Accepted

2.3.7 Force Analysis – Accepted

2.3.7.1 Shear Stress – Accepted

2.3.7.2 Buoyant Weight of Structure – Accepted

2.3.7.3 Impact, Drag and Hydrodynamic Lift Forces – Accepted

2.3.7.4 Turning Force – Accepted

2.3.7.5 Friction – Accepted

2.3.7.6 Frost Heave – Accepted

2.3.7.7 Seepage Uplift Pressure – Accepted

2.3.7.8 Dynamic Pressure Fluctuations – Accepted

2.3.7.9 Overall Analysis – Accepted

2.4 Simplified Drop Structure Designs for District's Grass-Lined Channels

2.4.1 Introduction and Cautions – Accepted

2.4.2 Applicability of Simplified Channel Drop Designs – Accepted

2.4.3 Simplified Grouted Sloping Boulder Drop Design – Accepted

2.4.4 Vertical Hard Basin Drops – Accepted

2.5 Baffle Chute Drops – Accepted

2.6 Seepage Control – Accepted

2.6.1 Seepage Analysis Methods – Accepted

2.6.2 Foundation/Seepage Control Systems – Accepted

2.7 Simplified Minimum Design Approach for Boatable Channels – Deleted

2.8 Construction Concerns: Grass-Lined Channels – Accepted

2.8.1 Foundation/Seepage Control – Accepted

2.8.2 Baffle Chute Construction – Accepted

2.8.3 Vertical Hard Basin Construction – Accepted

2.8.4 Sloping Grouted Boulder Construction – Accepted

2.9 Low-Flow Check and Wetland Structures – Accepted

3.1 General – Accepted

3.2 Impact Stilling Basin – Accepted

3.2.1 Modified Impact Basins for Smaller Outlets – Accepted

3.2.2 Low-flow Modifications – Accepted

3.2.3 Multiple Conduit Installations – Accepted

3.2.4 General Design Procedure for Type IV Impact Basin – Accepted

3.3 Pipe Outlet Rundowns – Accepted

3.3.1 Baffle Chute Rundown – Accepted

3.3.2 Grouted Boulder Chute Rundown – Accepted

3.4 Low Tailwater Riprap Basins at Pipe Outlets

3.4.1 General – Accepted

3.4.2 Objective – Accepted

3.4.3 Low Tailwater Basin Design – Accepted

3.4.3.1 Finding Flow Depth and Velocity of Storm Sewer Outlet Pipe – Accepted

3.4.3.2 Riprap Size – Accepted

3.4.3.3 Basin Length – Accepted

3.4.3.4 Basin Width – Accepted

3.4.3.5 Other Design Requirements – Accepted

3.5 Culvert Outlets – Accepted

4.0 BRIDGES

4.1 Basic Criteria – Accepted

4.1.1 Design Approach – Accepted

4.1.2 Bridge Opening Freeboard – Amended

Add:

"The bridge low chord elevation shall be a minimum 1-foot above the 100-year water energy grade line."

4.2 Hydraulic Analysis – Accepted

4.2.1 Expression for Backwater – Accepted

4.2.2 Backwater Coefficient – Accepted

4.2.3 Effect of M and Abutment Shape (Base Curves) – Accepted

4.2.4 Effect of Piers (Normal Crossings) – Accepted

4.3 Design Procedure – Accepted

5.0 TRANSITIONS AND CONSTRICTIONS

5.1 Introduction – Accepted

5.2 Transition Analysis – Accepted

5.2.1 Subcritical Transitions – Accepted

5.2.2 Supercritical Transition Analysis – Accepted

5.3 Constriction Analysis – Accepted

5.3.1 Constrictions With Upstream Subcritical Flow – Accepted

6.0 BENDS AND CONFLUENCES

6.1 Introduction – Accepted

6.2 Bends – Accepted

6.2.1 Subcritical Bends – Accepted

6.2.2 Supercritical Bends – Accepted

6.3 Confluences – Accepted

6.3.1 Subcritical Flow Confluence Design – Accepted

7.0 RUNDOWNS

7.1 Cross Sections – Accepted

7.2 Design Flow – Accepted

7.3 Flow Depth – Accepted

7.4 Outlet Configuration for Trickle Channel – Accepted

7.5 Outlet Configuration for Wetland Channel – Accepted

7.6 Grouted Boulder Rundowns – Accepted

8.0 MAINTENANCE

8.1 General – Accepted

8.2 Access – Accepted

8.3 Maintenance Optimization – Accepted

9.0 BOATABLE DROPS – Accepted

CULVERTS

1.0 INTRODUCTION AND OVERVIEW – Accepted

1.1 Required Design Information – Accepted

1.1.1 Discharge – Accepted

1.1.2 Headwater – Amended

Add:

The maximum culvert headwater to diameter ratios is:

STORM FREQUENCY	HEADWATER TO DIAMETER
10-Year	HW/D < 1.0
100-Year	HW/D < 1.5

The minimum culvert capacities are:

STREET CLASSIFICATION	MINIMUM CAPACITY (RECURRENCE INTERVAL)
Local	10-Year
Collector	10-Year
Arterial	10-Year

When the flow exceeds the capacity of the culvert and overtops the cross street, the flow over the street crown shall not exceed the minor storm and major storm depth limits presented in Chapter 3, Planning, Section 9.4 of the manual. Lyons may require additional culvert capacity in order to prevent flooding of adjacent properties.

1.1.3 Tailwater – Accepted

1.1.4 Outlet Velocity – Accepted

2.0 CULVERT HYDRAULICS

2.1 Key Hydraulic Principles – Accepted

2.1.1 Energy and Hydraulic Grade Lines – Amended

Add:

"The hydraulic grade line and energy grade line shall be determined for each culvert system and included in the Final Drainage Report. Each culvert system shall be profiled on the Final Construction Drawings and shall include the design flow hydraulic grade line."

2.1.2 Inlet Control – Accepted

2.1.3 Outlet Control – Accepted

2.2 Energy Losses – Accepted

2.2.1 Inlet Losses – Accepted

2.2.2 Outlet Losses – Accepted

2.2.3 Friction Losses – Accepted

3.0 CULVERT SIZING AND DESIGN

3.2 Use of Capacity Charts – Accepted

3.3 Use of Nomographs – Accepted

3.4 Computer Applications, Including Design Spreadsheet – Accepted

3.5 Design Considerations – Accepted

3.5.1 Design Computation Forms – Accepted

3.5.2 Invert Elevations – Accepted

3.5.3 Culvert Diameter – Amended

Add:

"Lyons requires a minimum culvert diameter of 15 inches. Lyons may require additional culvert capacity in order to prevent flooding of adjacent properties."

Add:

"The Manning's roughness coefficient "n" for all culvert pipe sizing calculations shall be 0.013 regardless of pipe material (Concrete, PVC, or HDPE) with the exception of corrugated metal pipes which shall have a coefficient of 0.025."

3.5.4 Limited Headwater – Accepted

3.6 Culvert Outlet – Accepted

3.7 Minimum Slope – Accepted

4.0 CULVERT INLETS

4.1 Projecting Inlets – Amended

Add:

At a minimum, a culvert entrance and outlet shall include a flared end section. Erosion protection (riprap, etc.) may be required.

4.1.1 Corrugated Metal Pipe – Accepted

4.1.2 Concrete Pipe – Accepted

4.2 Inlets with Headwalls – Accepted

4.2.1 Corrugated Metal Pipe – Accepted

4.2.2 Concrete Pipe – Accepted

4.2.3 Wingwalls – Accepted

4.2.4 Aprons 24 – Accepted

4.3 Special Inlets – Accepted

4.3.1 Corrugated Metal Pipe – Accepted

4.3.2 Concrete Pipe – Accepted

4.3.3 Mitered Inlets – Accepted

4.3.4 Long Conduit Inlets – Accepted

4.4 Improved Inlets – Accepted

5.0 Inlet Protection

5.1 Debris Control – Accepted

5.2 Buoyancy – Accepted

6.0 OUTLET PROTECTION

6.1 Local Scour – Accepted

6.2 General Stream Degradation – Accepted

7.0 GENERAL CONSIDERATIONS

7.1 Culvert Location – Accepted

7.2 Sedimentation – Accepted

7.3 Fish Passage – Accepted

7.4 Open Channel Inlets – Accepted

7.5 Transitions – Accepted

7.6 Large Stormwater Inlets – Accepted

7.6.1 Gratings – Accepted

7.6.2 Openings – Accepted

7.6.3 Headwater – Accepted

7.7 Culvert Replacements – Accepted

7.8 Fencing for Public Safety – Accepted

8.0 TRASH/SAFETY RACKS – Amended

Change:

"The District strongly recommends against the installation of trash racks at culvert outlets, because debris or a person carried into the culvert will impinge against the rack, thus leading to pressurized conditions within the culvert, virtually destroying its flow capacity and creating a greater hazard to the public or a person trapped in the culvert than not having one."

To:

The town strongly recommends against the installation of trash racks at culvert outlets, because debris or a person carried into the culvert will impinge against the rack, thus leading to pressurized conditions within the culvert, virtually destroying its flow capacity and creating a greater hazard to the public or a person trapped in the culvert than not having one.

8.1 Collapsible Gratings – Amended

Change:

"The District does not recommend the use of collapsible gratings."

To:

Lyons does not recommend the use of collapsible gratings.

STORAGE

1.0 OVERVIEW – Accepted

2.0 APPLICATION OF DIFFERENT TYPES OF STORAGE – Amended

Add (6):

"Above ground parking lot detention ponds may be utilized when land area for a grassed lined detention pond is not available. To prevent damage to and floatation of automobiles, parking lot detention ponds shall not exceed 12 inches in depth at any point. Parking lot detention ponds shall have signage to inform the general public about the potential for flooding. The 100-year water surface elevation of a parking lot detention pond shall not encroach into a public street."

3.0 HYDROLOGIC AND HYDRAULIC DESIGN BASIS

3.1 Procedures for the Sizing of Storage Volumes – Accepted

3.1.1 Use of Simplified On-Site Detention Sizing Procedures – Accepted

3.1.2 Use of Hydrograph Routing Detention Sizing Procedure – Amended

Change:

"Whenever the area limits described above in Section 3.1.1. are exceeded (for tributary catchments larger than 90 acres for empirical equations and FAA Method and 160 acres for the *Full Spectrum Detention* method), the District recommends the use of hydrograph flood routing procedures (e.g., using CUHP- generated hydrographs and reservoir routing calculations)."

To:

Whenever the area limits described above in Section 3.1.1. are exceeded (for tributary catchments larger than 90 acres for empirical equations and FAA Method and 160 acres for the *Full Spectrum Detention* method), the town recommends the use of hydrograph flood routing procedures (e.g., using CUHP- generated hydrographs and reservoir routing calculations).

Add:

"Sizing of detention storage volumes shall utilize outflow hydrographs that have been properly calculated to account for variable head discharge rates.

3.1.3 Water Quality Capture Volume in Sizing Detention Storage – Amended

Add:

"The water quality capture volume shall be considered a portion of the total 100-yr detention pond volume."

3.2 Sizing of On-Site Detention Facilities

3.2.1 Maximum Allowable Unit Release Rates for On-Site Facilities – Amended

Change:

"These maximum releases rates will apply for all on-site detention facilities unless other rates are recommended in a District- approved master plan."

To:

These maximum releases rates will apply for all on-site detention facilities unless other rates are recommended in the town master plan.

3.2.2 Empirical Equations for the Sizing of On-Site Detention Storage Volumes – Amended

Change:

"The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within the District."

To:

The following set of empirical equations provided preliminary estimates of on-site detention facility sizing for areas within Lyons.

Change:

"If the District has a master plan that contains specific guidance for detention storage or sizing of on-site detention facilities, those guidelines should be followed instead."

To:

Where the town's master plan contains specific guidance for detention storage or sizing of on-site detention facilities, those guidelines should be followed instead.

3.2.3 Rational Formula-Based Modified FAA Procedure – Accepted

3.2.4 Simplified Full-Spectrum Detention Sizing (Excess Urban Runoff Flow Control) – Accepted

3.2.5 Excess Urban Runoff Flow Control at Regional Facilities – Accepted

3.2.6 Multi-Level Control – Amended

Change:

"The District recommends that no more than two levels of controls, in addition to the WQCV controls, be used for on-site detention facilities."

To:

The town recommends that no more than two levels of controls, in addition to the WQCV controls, be used for on-site detention facilities.

3.2.7 On-Site Detention and UDFCD 100-year Floodplain Management Policy – Accepted

3.3 Design Storms for Sizing Storage Volumes – Amended

Add:

The 10-year and 100-year storms shall be the design storms for all water quality and detention pond designs, respectively, within Lyons. Each storm should be detained to be released at the historic rate for each respective storm.

3.3.1 Water Quality Capture Volume – Accepted

3.3.2 Drainage and Flood Control – Amended

Change:

"Whenever a District-approved master plan recommends detention sites and release rates, or on-site detention/retention storage and release rates, this sizing and rates should be used in final design of detention/retention facilities."

To:

Whenever a town-approved master plan recommends detention sites and release rates, or on-site detention/retention storage and release rates, this sizing and rates should be used in final design of detention/retention facilities.

3.3.3 Spillway Sizing – Amended

Add:

"Each detention pond shall contain an emergency spillway capable of conveying the peak 100-year storm discharge draining into the detention pond. The invert of the emergency spillway shall be set equal to or above the 100-year water surface elevation. The depth of flow out the emergency spillway shall be < 6 inches and the spillway shall have effective erosion protection."

3.3.4 Retention Facilities – Amended

Change:

"When a retention basin is proposed as a temporary solution, the District recommends that it be sized to capture, as a minimum, the runoff equal to 1.5 times the 24-hour, 100-year storm plus 1-foot of freeboard."

To:

When a retention basin is proposed as a temporary solution, the town recommends that it be sized to capture, as a minimum, the runoff equal to 1.5 times the 24-hour, 100-year storm plus 1-foot of freeboard.

Add:

"The town will not approve any detention or retention pond that does not drain in less than 72 hours, or causes injury to water rights, or is in violation of State or Federal law.

3.4 Reservoir Routing of Storm Hydrographs for Sizing of Storage Volumes – Amended

Change (2):

"Determine the inflow hydrograph to the storage basin and the allowable peak discharge from the basin for the design storm events. The hydrograph may be available in published district outfall system planning or a major drainageway master plan report. The allowable peak discharge is limited by the local criteria or by the requirements spelled out in a District-approved master plan.

To:

The allowable peak discharge is limited by the local criteria or by the requirements spelled out in a town-approved master plan.

3.4.1 Initial Sizing – Accepted

3.4.2 Initial Shaping – Amended

Change:

"This does not mean that the District encourages the use of storage facilities with uniform geometric properties. To the contrary, the District encourages designers to collaborate with landscape architects to develop storage facilities that are visually attractive, fit into the fabric of the landscape, and enhance the overall character of an area."

To:

This does not mean that the town encourages the use of storage facilities with uniform geometric properties. To the contrary, the town encourages designers to collaborate with landscape architects to develop storage facilities that are visually attractive, fit into the fabric of the landscape, and enhance the overall character of an area.

3.4.3 Outlet Works Design – Accepted

3.4.4 Preliminary Design – Accepted

3.4.5 Final Design – Accepted

4.0 FINAL DESIGN CONSIDERATIONS – Amended

Change:

"The District urges all designers to review and adhere to the guidance in such references because the failure of even small embankments can have serious consequences for the public and the municipalities downstream of the embankment."

To:

The town urges all designers to review and adhere to the guidance in such references because the failure of even small embankments can have serious consequences for the public and the municipalities downstream of the embankment.

4.1 Storage Volume – Accepted

4.2 Potential for Multiple Uses – Accepted

4.3 Geometry of Storage Facilities – Accepted

4.3 Geometry of Storage Facilities – Amended

Change:

"Several key features should be incorporated in all storage facilities located within the District."

To:

Several key features should be incorporated in all storage facilities located within Lyons.

4.4 Embankments and Cut Slopes – Amended

Change (2):

"Freeboard – The elevation of the top of the embankment shall be a minimum of 1 foot above the water surface elevation when the emergency spillway is conveying the maximum design or emergency flow."

To:

Freeboard – The elevation of the top of the embankment shall be a minimum of 1 foot above the 100-year water surface elevation in the detention pond.

Add (5):

Emergency Spillway Downstream Protection – In order to protect the emergency spillway from catastrophic erosion failure, buried riprap shall be placed from the emergency spillway downhill to the embankment toe of slope and covered with 6 inches of topsoil. The riprap shall be sized at the time of final engineering design. Grouting of the riprap may be required

Add (6):

Concrete Cutoff Wall – A concrete cutoff wall, 8 inches thick, 3 foot deep, extending 5 feet into the embankment beyond the emergency spillway opening, is encouraged on all private detention ponds and required on all publicly-owned regional detention ponds. A concrete cutoff wall will permanently define the emergency spillway opening. The emergency spillway elevation shall be tied back into the top of embankment using a maximum slope of 4:1.

4.5 Linings – Accepted

4.6 Inlets – Accepted

4.7 Outlet Works – Amended

Add:

The outlet pipe of regional detention ponds shall contain a minimum of two (2) concrete cutoff walls embedded a minimum of 18" into undisturbed earthen soil. The cutoff walls shall be a

minimum of 8 inches thick. The outlet pipe bedding material shall consist of native earthen soil and not granular bedding material to at least the first downstream manhole or daylight point.

4.8 Trash Racks – Amended

Add:

For safety reasons, trash rack angles are to be 3 horizontal to 1 vertical (3:1) or flatter per Urban Drainage research (Nelson & Kroeger, 2005).

4.9 Vegetation – Accepted

4.10 Operation and Maintenance – Amended

Add (15):

An operations maintenance manual for each water quality pond, detention pond, and outlet structure facility shall be developed and provided to the town at the time of final submittal.

4.11 Access – Amended

Add:

Drivable access applies only to Regional Detention facilities within Lyons. Each regional detention pond will be considered on a case-by-case basis at the time of final design.

4.12 Geotechnical Considerations – Accepted

4.13 Environmental Permitting and Other Considerations – Accepted

5.0 DISTRICT MAINTENANCE ELIGIBILITY FOR DETENTION FACILITIES – Amended

Add:

Regional Master Planned detention ponds, designed and constructed by or on behalf of Lyons, shall be owned and maintained by the town as specified in the applicable Development Agreement(s). All other detention ponds shall be considered privately owned and privately maintained.

6.0 DESIGN EXAMPLES – Accepted

6.1 Example—Empirical Equations Sizing of a Detention Basin
6.2 Example—Rational Method Analysis
6.3 Example—Hydrograph Procedure Preliminary Sizing

7.0 CHECKLIST – Accepted

8.0 REFERENCES

FLOOD PROOFING

1.0 FLOOD PROOFING

1.1 Definition of Flood Proofing – Accepted

1.2 Overview of Flood-Proofing Methods – Accepted

1.2.1 Classification of Flood Proofing – Amended

Change:

"In the Denver metropolitan area, flood-proofing efforts should focus on permanent measures due to the rapid response of most of the Front Range stream systems."

To:

"In Lyons, flood-proofing efforts should focus on permanent measures due to the rapid response of most of the Front Range stream systems."

1.2.2 FEMA Recommended Methods – Accepted

1.3 Approach of Manual Relative to Flood-Proofing Guidance – Accepted

1.4 Regulatory Considerations – Accepted

1.5 Flood Proofing In the Context of Overall Floodplain Management – Accepted

2.0 WHEN TO FLOOD PROOF

2.1 How Flooding Can Damage Structures – Accepted

2.1.1 Depth/Elevation of Flooding – Accepted

2.1.2 Flow Velocity – Accepted

2.1.3 Flood Frequency – Accepted

2.1.4 Rate of Rise and Rate of Fall – Accepted

2.1.5 Duration – Accepted

2.1.6 Debris Impact – Accepted

2.2 When Flood Proofing is Not Appropriate – Accepted

2.3 Typical Causes of Flooding Problems – Accepted

2.3.1 Inadequate Street Conveyance – Accepted

2.3.2 Inadequate Storm Sewer Conveyance – Accepted

2.3.3 Inadequate Drainage Channel Conveyance – Accepted

2.3.4 Sewage Backup– Accepted

3.0 FLOOD PROOFING METHODS

3.1 Overview of Six Methods Identified by FEMA – Accepted

3.1.1 Elevation – Accepted

3.1.2 Wet Flood Proofing – Accepted

3.1.3 Dry Flood Proofing– Accepted

3.1.4 Relocation– Accepted

3.1.5 Levees and Floodwalls – Accepted

3.1.6 Demolition– Accepted

3.2 Engineering Aspects– Accepted

3.2.1 Analysis of Flood Hazards– Accepted

3.2.2 Site Characteristics– Accepted

3.2.3 Building Characteristics – Accepted

3.3 Selection of Flood-Proofing Techniques – Accepted

3.3.1 Regulatory Considerations – Accepted

3.3.2 Appearance – Accepted

3.3.3 Accessibility – Accepted

3.3.4 Human Intervention Required – Accepted

3.3.5 Benefit/Cost Analysis – Accepted

3.3.6 Other – Accepted

4.0 PROVIDING ASSISTANCE TO PROPERTY OWNERS

4.1 Decision Making Process for Property Owners– Accepted

4.1.1 Determine Flood Hazards – Amended

Change:

“Information about flooding in the area is available from the District and local officials.”

To:

"Information about flooding in the area is available from the Town of Lyons."

4.1.2 Inspect Structure – Accepted

4.1.3 Contact Local Officials – Accepted

4.1.3 Contact Local Officials – Amended

Change:

"The District and local officials have copies of the FIS and FIRM published for the community by FEMA."

To:

"The town and local officials have copies of the FIS and FIRM published for the community by FEMA."

4.1.4 Consult With Professionals – Accepted

4.2 Potential Sources of Financial Assistance at Federal, State, and Local Levels – Accepted

5.0 REFERENCES

REVEGETATION

1.0 INTRODUCTION – Amended

Change:

"This chapter provides information on methods and plant materials needed for revegetation of drainage facilities within the Urban Drainage and Flood Control District (District)."

To:

This chapter provides information on methods and plant materials needed for revegetation of drainage facilities within the town of Lyons.

Change:

"The semi-arid nature of the climate, prevalence of introduced weeds, and variety of soil types encountered in the District virtually mandate prompt implementation of a revegetation plan to achieve revegetation success."

To:

The semi-arid nature of the climate, prevalence of introduced weeds, and variety of soil types encountered in Lyons virtually mandate prompt implementation of a revegetation plan to achieve revegetation success. Specific consideration of native plant species and their inherent limitations and advantages should be part of every revegetation plan."

2.0 SCOPE OF THIS CHAPTER AND RELATION TO OTHER RELEVANT DOCUMENTS – Amended

Add:

See revisions to RV tables included in this chapter for seed mix recommendations.

3.0 GENERAL GUIDELINES FOR REVEGETATION

3.1 Plant Materials – Accepted

3.2 Site Preparation – Amended

Add:

Before revegetation work is started, an inventory of vegetation should be taken. If noxious weeds, as listed on the State of Colorado index, exist on-site, appropriate steps need to be taken before, during, and after work is completed, to control their spread. Contact the Town of Lyons for additional information if needed.

3.3 Seeding and Planting – Amended

Add:

Seed mixtures should be coated with Mycorrhiza at the rate of 2 pounds per acre at the time of seeding. If mulching with straw, be sure the straw is seed free and weed free.

3.4 Maintenance – Amended

Change:

"Access to and grazing on recently revegetated areas should be limited with temporary fencing and signage while plants are becoming established (normally the first year)."

To:

Access to and grazing on recently revegetated areas should be limited with temporary fencing and signage while plants are becoming established (for 1 to 2 years at least).

Change:

"Weed infestations should be managed using appropriate physical, chemical, or biological methods as soon as possible. (See the other documents referenced for details on weed management options.)"

To:

Weed infestations should be managed using appropriate physical or chemical methods as soon as possible.

Add:

The project owners/developer, not Lyons, will be responsible for site maintenance until vegetative establishment.

4.0 PREPARATION OF A PLANTING PLAN

4.1 General – Accepted

4.2 Soil Amendments – Amended

Change:

"Since soil pH is typically suitable within the District, amendments are usually needed for increasing organic matter content or providing nutrients in the form of fertilizers."

To:

"Since soil pH is typically suitable within Lyons, amendments are usually needed for increasing organic matter content or providing nutrients in the form of fertilizers."

Change:

"Consideration should be given to importing topsoil, instead of amending poor quality subsoil, as this may be less expensive."

To:

"Consideration should be given to importing topsoil, from the vicinity, instead of amending poor quality subsoil, as this may be less expensive."

Change:

"Both of these materials are relatively new and show promise as soil conditioners and sources of slow-release fertilizers for revegetation work in the District."

To:

Both of these materials are relatively new and show promise as soil conditioners and sources of slow-release fertilizers for revegetation work in the town.

4.2.1 Humate Conditioner – Accepted

4.2.2 Biosol – Accepted

4.3 Recommended Seed Mixes – Amended

Change:

"Recommended seed mixes for the bottom (wet soils) and side slopes of drainage facilities within the District are included in Tables RV-1 and RV-2."

To:

Recommended seed mixes for the bottom (wet soils) and side slopes of drainage facilities within Lyons are included in Tables RV-1 and RV-2.

Add:

The inclusion of wild flowers in the seed mix is optional in Lyons. Areas seeded along Boulder County roads may be spot sprayed in the county to control the spread of noxious weeds. This spraying may affect some wild flower species. Do not plant trees or shrubs in the town right-of-way.

Delete:

Redtop (Agrostis alba) from Table RV-1

Nuttall's sunflower (Holianthus nuttallii) from Table RV-1

Canadian bluegrass (Ruebens) (Poa compressa) from Table RV-2

Flax* (Linum lewisii) from Table RV-2

Blue Flax (Linum lewisii) from Table RV-3

Canby bluegrass (Poa canbyi) from Table RV-4

Flax (Linum lewisii) from Table RV-4

Change:

Common Name (Variety)	Scientific Name	Growth Season	Growth Form	Seeds/Lb	Lbs PLS/Acre
Blue grama (Hachita)	*Chondrosum gracile*	Warm	Sod/bunch	825,000	2.1

To:

Blue grama (Hachita)	*Chondrosum gracile*	Warm	Sod/bunch	825,000	0.3

Change:

Common Name (Variety)	Scientific Name	Growth Season	Growth Form	Seeds/Lb	Lbs PLS/Acre
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	5,298,000	0.3

To:

Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	5,298,000	2.1

Delete:

Flax (Linum lewisii) from Table RV-5

Blue Flax (Linum lewisii) from Table RV-7

California poppy (Eschscholtzia californica) from Table RV-7

Blackeyed Susan (Rudbeckia hirta) from Table RV-7

Rubber rabbitbrush (Chrysothamnus nauseosus) from Table RV-8

Spanish bayonet (Yucca glauca) from Table RV-8

Smart weed (Polygonum persicaria) from Table RV-9

Foxtail barley (Hordeum jubatum) from Table RV-9

Refer to Grass Seeding Recommendations for Boulder County:

4.4 Trees, Shrubs and Wetland Plantings – Accepted

4.5 Mulching – Amended

Add:

- At least 70 percent of the mulch by weight shall be 10 inches or more in length.
- The appropriate use of fabric blankets under trees and shrubs is suggested

4.6 Bioengineering – Accepted

4.7 Collection of Live Stakes, Willow Cuttings, and Poles – Accepted

4.7.1 Harvest Procedure – Accepted

4.7.2 Installation – Accepted

5.0 POST-CONSTRUCTION MONITORING – Amended

Change:

"This is especially important for establishing native species since it may take several years for vegetation to become adequately established. Sites should be observed several times during their first two growing seasons and at least once a year thereafter."

To:

"This is especially important for establishing native species since it may take three to five years for vegetation to become adequately established. Sites should be observed several times during their first two or three growing seasons and at least twice a year thereafter."

6.0 REFERENCES

DESIGN EXAMPLES – Accepted

Add:

Use the UDFCD C1, C2, C3 coefficients within the "Detention Volume by Modified FAA Method" spreadsheet.

USCDM VOLUME 3

PREFACE

1.0 Acknowledgements – Accepted

2.0 Purpose – Accepted

3.0 Overview – Accepted

4.0 Revisions to USDCM Volume 3 – Accepted

5.0 Acronyms and Abbreviations – Accepted

CHAPTER 1 - STORMWATER MANAGEMENT AND PLANNING

1.0 Introduction – Accepted

2.0 Urban Stormwater Characteristics – Accepted

3.0 Stormwater Management Requirements under the Clean Water Act – Accepted

3.1 Clean Water Act Basics – Accepted

3.2 Colorado's Stormwater Permitting Program – Accepted

3.2.1 Construction Site Stormwater Runoff Control – Accepted

3.2.2 Post-construction Stormwater Management – Accepted

3.2.3 Pollution Prevention/Good Housekeeping – Accepted

3.3 Total Maximum Daily Loads and Stormwater Management – Accepted

4.0 Four Step Process to Minimize Adverse Impacts of Urbanization – Amended

Change:

"UDFCD has long recommended a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls."

To:

Lyons recommends a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

4.1 Step 1. Employ Runoff Reduction Practices – Accepted

4.2 Step 2. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release – Accepted

4.3 Step 3. Stabilize Drainageways – Accepted

Change:

"Many drainageways within UDFCD boundaries are included in major drainageway or outfall systems plans, identifying needed channel stabilization measures."

To:

The Lyons master plan identifies needed channel stabilization measures along drainageway in the town.

4.4 Step 4. Implement Site Specific and Other Source Control BMPs – Accepted

5.0 Onsite, Subregional and Regional Stormwater Management – Accepted

6.0 Conclusion – Amended

Change:

“UDFCD criteria are based on a Four Step Process focused on reducing runoff volumes, treating the remaining WQCV, stabilizing receiving drainageways and providing targeted source controls for post-construction operations at a site.”

To:

Lyons criteria is based on Four Step Process focused on reducing runoff volumes, treating the remaining WQCV, stabilizing receiving drainageways and providing targeted source controls for post-construction operations at a site.

7.0 References

Chapter 2 - BMP Selection

1.0 BMP Selection – Accepted

1.1 Physical Site Characteristics – Accepted

1.2 Space Constraints – Accepted

1.3 Targeted Pollutants and BMP Processes – Accepted

1.4 Storage-Based Versus Conveyance-Based – Accepted

1.5 Volume Reduction – Accepted

1.6 Pretreatment – Accepted

1.7 Treatment Train – Accepted

1.8 Online Versus Offline Facility Locations – Accepted

1.9 Integration with Flood Control – Accepted

1.9.1 Sedimentation BMPs – Accepted

1.9.2 Infiltration/Filtration BMPs – Accepted

1.10 Land Use, Compatibility with Surroundings, and Safety – Accepted

1.11 Maintenance and Sustainability – Accepted

1.12 Costs – Accepted

2.0 BMP Selection Tool – Accepted

3.0 Life Cycle Cost and BMP Performance Tool – Accepted

3.1 BMP Whole Life Costs – Amended

Change:

"In addition, UDFCD recommends the cost of administering a stormwater management program also be included as a long-term cost for BMPs. Reporting whole life costs in terms of net present value (NPV) is an effective method for comparing mutually exclusive alternatives (Newnan 1996)."

To:

In addition, the cost of administering a stormwater management program also be included as a long-term cost for BMPs. Reporting whole life costs in terms of net present value (NPV) is an effective method for comparing mutually exclusive alternatives (Newnan 1996).

Change:

“All cost estimates are considered "order-of-magnitude" approximations, hence UDFCD's recommendation of using this concept primarily at the planning level.”

To:

All cost estimates are considered "order-of-magnitude" approximations, hence the Town’s recommendation of using this concept primarily at the planning level.

Change:

- **“Contingency/Engineering/Administration Costs:** The additional costs of designing and permitting a new BMP are estimated as a percentage of the total construction costs. For Denver-area projects, a value of 40% is recommended if no other information is available.”

To:

- **Contingency/Engineering/Administration Costs:** The additional costs of designing and permitting a new BMP are estimated as a percentage of the total construction costs. For Lyons projects, a value of 40% is recommended if no other information is available.

Change:

- **“Administration Costs:** The costs of administering a stormwater management program are estimated as percentage of the average annual maintenance costs of a BMP. For Denver-area projects, a value of 12% is recommended if no other information is available.”

To:

- **“Administration Costs:** The costs of administering a stormwater management program are estimated as percentage of the average annual maintenance costs of a BMP. For Lyons projects, a value of 12% is recommended if no other information is available.”

3.2 BMP Performance

Change:

“Instead, UDFCD recommends an approach that is expected to predict long-term (i.e. average annual) BMP pollutant removal and runoff volume reduction with reasonable accuracy, using BMP performance data reported in the International Stormwater BMP Database (as discussed in Section 1.3).”

To:

“Instead, Lyons recommends an approach that is expected to predict long-term (i.e. average annual) BMP pollutant removal and runoff volume reduction with reasonable accuracy, using BMP performance data reported in the International Stormwater BMP Database (as discussed in Section 1.3).”

Chapter 3 – Calculating the WQCV and Volume Reduction

Chapter 4 – Treatment BMPs

1.0 Overview – Accepted

2.0 Treatment BMP Fact Sheets – Amended

Change:

"UDFCD does not provide endorsement or approval of specific practices; instead, guidance is provided identifying when use of underground BMPs may be considered and the minimum criteria that should be met when site constraints do not enable aboveground treatment of runoff or when underground devices are used to provide pretreatment for site-specific or watershed-specific purposes."

To:

Lyons does not provide endorsement or approval of specific practices; instead, guidance is provided identifying when use of underground BMPs may be considered and the minimum criteria that should be met when site constraints do not enable aboveground treatment of runoff or when underground devices are used to provide pretreatment for site-specific or watershed-specific purposes.

3.0 References

Treatment BMP Fact Sheets

T-1 Grass Buffer – Accepted

T-2 Grass Swale – Accepted

T-3 Bioretention (Rain Garden or Porous Landscape Detention) – Accepted

T-4 Green Roof – Accepted

T-5 Extended Detention Basin (EDB) – Accepted

T-6 Sand Filter – Accepted

T-7 Retention Pond – Amended

Add:

Retention facilities are normally not allowed in Lyons, but will be considered for special circumstances.

Retention facilities shall be sized to contain a volume equal to twice the 100-year storm runoff volume plus one foot of freeboard. Water within a retention facility shall be mechanically removed and disposed of off-site by the property owner within 48 hours after a storm event. Lyons will not approve any detention or retention pond that does not drain in less than 72 hours, or causes injury to water rights, or is in violation of State or Federal law.

T-8 Constructed Wetland Pond – Accepted

T-9 Constructed Wetland Channel – Accepted

T-10 Permeable Pavements: – Accepted

T-10.1 Permeable Interlocking Concrete Pavements (PICP) – Accepted

T-10.2 Concrete Grid Pavement – Accepted

T-10.3 Pervious Concrete – Accepted

T-10.4 Porous Gravel Pavement – Accepted

T-10.5 Reinforced Grass Pavement – Accepted

T-11 Underground BMPs – Accepted

T-12 Outlet Structures – Accepted

Chapter 5 – Source Control BMPs

1.0 Introduction – Accepted

2.0 Structural Source Controls – Accepted

3.0 Procedural Source Control BMPs – Accepted

3.1 Municipal Operations – Accepted

3.2 Commercial and Industrial Operations – Accepted

3.3 Residential Activities – Accepted

4.0 Combining Source Control BMPs to Target Pollutants of Concern – Accepted

5.0 References

Source Control BMP Fact Sheets

S-1 Covering Outdoor Storage and Handling Areas – Accepted

S-2 Spill Prevention, Containment and Control – Accepted

S-3 Disposal of Household Waste – Accepted

S-4 Illicit Discharge Controls – Accepted

S-5 Good Housekeeping – Accepted

S-6 Preventative Maintenance – Accepted

S-7 Vehicle Maintenance, Fueling and Storage – Accepted

S-8 Use of Pesticides, Herbicides and Fertilizers – Accepted

S-9 Landscape Maintenance – Accepted

S-10 Snow and Ice Management – Accepted

S-11 Street Sweeping and Cleaning – Accepted

S-12 Storm Sewer System Cleaning – Accepted

Chapter 6 – BMP Maintenance

1.0 Introduction – Accepted

2.0 Defining Maintenance Responsibility for Public and Private Facilities – Accepted

3.0 Developing a Maintenance Plan – Accepted

4.0 Grass Buffers and Swales – Accepted

4.1 Inspection – Accepted

4.2 Debris and Litter Removal – Accepted

4.3 Aeration – Accepted

4.4 Mowing – Accepted

4.5 Irrigation Scheduling and Maintenance – Accepted

4.6 Fertilizer, Herbicide, and Pesticide Application – Accepted

4.7 Sediment Removal – Accepted

5.0 Bioretention (Rain Garden or Porous Landscape Detention) – Accepted

5.1 Inspection – Accepted

5.2 Debris and Litter Removal – Accepted

5.3 Mowing and Plant Care – Accepted

5.4 Irrigation Scheduling and Maintenance – Accepted

5.5 Replacement of Wood Mulch – Accepted

5.6 Sediment Removal and Growing Media Replacement – Accepted

6.0 Green Roofs – Accepted

6.1 Inspection – Accepted

6.2 Plant Care and Media Replacement – Accepted

6.3 Irrigation Scheduling and Maintenance – Accepted

7.0 Extended Detention Basins (EDBs) – Accepted

7.1 Inspection – Accepted

7.2 Debris and Litter Removal – Accepted

7.3 Mowing and Plant Care – Accepted

7.4 Aeration – Accepted

7.5 Mosquito Control – Accepted

7.6 Irrigation Scheduling and Maintenance – Accepted

7.7 Sediment Removal from the Forebay, Trickle Channel, and Micropool – Accepted

7.8 Sediment Removal from Basin Bottom – Accepted

7.9 Erosion and Structural Repairs – Accepted

8.0 Sand Filters – Accepted

8.1 Inspection – Accepted

8.2 Debris and Litter Removal – Accepted

8.3 Filter Surface Maintenance – Accepted

8.4 Erosion and Structural Repairs – Accepted

9.0 Retention Ponds and Constructed Wetland Ponds – Accepted

9.1 Inspection – Accepted

9.2 Debris and Litter Removal – Accepted

9.3 Aquatic Plant Harvesting – Accepted

9.4 Mosquito Control – Accepted

9.5 Sediment Removal from the Forebay – Accepted

9.6 Sediment Removal from the Pond Bottom – Accepted

10.0 Constructed Wetland Channels – Accepted

10.1 Inspection – Accepted

10.2 Debris and Litter Removal – Accepted

10.3 Aquatic Plant Harvesting – Accepted

10.4 Sediment Removal – Accepted

11.0 Permeable Pavement Systems – Accepted

11.1 Inspection – Accepted

11.2 Debris Removal, Sweeping, and Vacuuming – Accepted

11.3 Snow Removal – Accepted

11.4 Full and Partial Replacement of the Pavement or Infill Material – Accepted

12.0 Underground BMPs – Accepted

12.1 Inspection – Accepted

12.2 Debris Removal, Cartridge Replacement, and Vacuuming – Accepted

13.0 References

Chapter 7 – Construction BMPs

1.0 Introduction – Accepted

2.0 Fundamental Erosion and Sediment Control Principles

2.1 Erosion – Accepted

2.2 Sedimentation – Accepted

2.3 Effective Erosion and Sediment Control – Accepted

3.0 Colorado Construction Stormwater Discharge Permits – Accepted

3.1 Preparing and Implementing a Stormwater Management Plan (SWMP) – Accepted

3.1.1 General SWMP Recommendations – Accepted

3.1.2 SWMP Elements – Accepted

3.2 Inspections – Accepted

3.2.1 Inspection Frequency – Accepted

3.2.2 Inspection Records – Accepted

3.3 Maintenance – Accepted

3.4 Disposition of Temporary Measures – Accepted

3.5 2009 Federal Effluent Limitation Guidelines – Accepted

4.0 Overview of Construction BMPs – Accepted

4.1 Erosion Control Measures – Accepted

4.2 Sediment Control Measures – Accepted

4.3 Site Management – Accepted

4.4 Materials Management – Accepted

4.5 Proprietary BMPs – Accepted

5.0 BMP Selection and Planning – Accepted

5.1 Site Assessment – Accepted

5.2 Slope-Length and Runoff Considerations – Accepted

5.3 Using the Revised Universal Soil Loss Equation – Accepted

5.4 BMP Functions – Accepted

5.5 Consistency with Other Plans – Accepted

5.5.1 Drainage Plans – Accepted

5.5.2 Post Construction Stormwater Management – Accepted

5.5.3 Air Quality Plans – Accepted

5.6 Guidelines for Integrating Site Conditions and BMPs into a SWMP – Accepted

6.0 Construction Dewatering – Accepted

7.0 Construction in Waterways – Accepted

8.0 Considerations for Linear Construction Projects – Accepted

8.1 General Considerations – Accepted

8.2 Underground Utility Trenching Criteria – Accepted

9.0 References

Construction BMP Fact Sheets – Accepted

Erosion Controls

EC-1 Surface Roughening (SR) – Accepted

EC-2 Temporary and Permanent Seeding (TS/PS) EC-3 Soil Binders (SB) – Accepted

EC-4 Mulching (MU) – Accepted

EC-5 Compost Blanket and Filter Berm (CB) – Accepted

EC-6 Rolled Erosion Control Products (RECP) (multiple types) – Accepted

EC-7 Temporary Slope Drains (TSD) – Accepted

EC-8 Temporary Outlet Protection (TOP) – Accepted

EC-9 Rough Cut Street Control (RCS) – Accepted

EC-10 Earth Dikes and Drainage Swales (ED/DS) – Accepted

EC-11 Terracing (TER) – Accepted

EC-12 Check Dams (CD) (multiple types) – Accepted

EC-13 Streambank Stabilization (SS) – Accepted

EC-14 Wind Erosion / Dust Control (DC) – Accepted

Materials Management

MM-1 Concrete Washout Area (CWA) – Accepted

MM-2 Stockpile Management (SP) (multiple types) – Accepted

MM-3 Good Housekeeping Practices (GH) – Accepted

Sediment Controls

SC-1 Silt Fence (SF) – Accepted

SC-2 Sediment Control Log (SCL) – Accepted

SC-3 Straw Bale Barrier (SBB) – Accepted

SC-4 Brush Barrier (BB) – Accepted

SC-5 Rock Sock (RS) – Accepted

SC-6 Inlet Protection (IP) (multiple types) – Accepted

SC-7 Sediment Basin (SB) – Accepted

SC-8 Sediment Trap (ST) – Accepted

SC-9 Vegetative Buffers (VB) – Accepted

SC-10 Chemical Treatment (CT) – Accepted

Site Management and Other Specific Practices

SM-1 Construction Phasing/Sequencing (CP) – Accepted

SM-2 Protection of Existing Vegetation (PV) – Accepted

SM-3 Construction Fence (CF) – Accepted

SM-4 Vehicle Tracking Control (VTC) (multiple types) – Accepted

SM-5 Stabilized Construction Roadway (SCR) – Accepted

SM-6 Stabilized Staging Area (SSA) – Accepted

SM-7 Street Sweeping and Vacuuming (SS) – Accepted

SM-8 Temporary Diversion Methods (TDM) – Accepted

SM-9 Dewatering Operations (DW) – Accepted

SM-10 Temporary Stream Crossing (TSC) (multiple types) – Accepted

SM-11 Temporary Batch Plant (TBP) – Accepted

SM-12 Paving and Grinding Operations (PGO) – Accepted