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LYNCHBURG CITY COUNCIL REPORT

16

MEETING DATE: April 23, 1996

REPORT NUMBER: _____

SYNOPSIS At a March work session, City Council received a progress report regarding the 1989 Combined Sewer Overflow (CSO) Control Plan. The purpose of this Plan is to achieve compliance over an extended, multi-year period with a Special Order of the Virginia Department of Environmental Quality (VDEQ) which requires the orderly elimination of approximately one hundred (100) points where storm drainage and sewerage are combined and sometimes overflow.

The Council-adopted CSO Control Plan is comprised of three (3) interrelated program components including (a) Combined Sewer Separation, (b) Interceptor Sewer Replacement, and (c) Rainleader Disconnect. Although completion of these program components will require up to several decades, the first two of these activities -- combined sewer separation, and interceptor sewer replacement -- are well underway. Initial "pilot" efforts are now complete for the Rainleader Disconnect Program which seeks to reduce some twenty percent (20%) of the troublesome overflow by removing that portion of storm-generated rainwater which is entering the system through building gutters or "rainleaders."

The aforementioned March work session focused primarily upon the presentation of a multiple-stepped approach for encouraging citizen cooperation in the disconnection of Rainleaders from the municipal sewer system. In order to proceed with this effort, the following actions are needed at this time:

- A. Adoption of a revision to section 34-11.1 of the City Code in order to require the disconnection of gutters from the sewer system and to prohibit future connections/reconnections;
- B. Adoption of a policy, as attached, to guide the implementation of the Rainleader Disconnect Program via promotion of voluntary compliance through incentive payments to citizens who act to disconnect these gutters; and
- C. Authorization to proceed with the first year of implementation of the overall Rainleader Disconnect Program and related CSO abatement activities via appropriation of additional funding of \$875,000 from the 1996-97 fiscal year allocation for this Program on page 63 in the Council-adopted 1995-2001 Capital Implementation Program (CIP).

The Physical Development Committee reviewed these matters and the following ordinance as well as resolutions are presented for City Council consideration.

REQUIRED ACTION

- A. Consideration of the attached ordinance to amend section 34-11.1 of the City Code
- B. BE IT RESOLVED That in accordance with the Special Order of the Virginia Department of Environmental Quality (VDEQ), a policy as entitled Rainleader Disconnect Program policies and guidelines, April 26, 1996, is adopted to guide the implementation of the Rainleader Disconnect Program.

#R-96-093

Adopted: April 23, 1996

Certified: Antonia W. Kost
Clerk of Council

cc: A. Booth
J. B. Martin
~~F. Reid~~

AN ORDINANCE TO AMEND AND REENACT THE CODE OF THE CITY OF LYNCHBURG, 1981, BY AMENDING SECTION 34-11.1, RELATING TO UNPOLLUTED WATER PROHIBITED IN SANITARY SEWERS.

BE IT ORDAINED BY THE COUNCIL OF THE CITY OF LYNCHBURG:

1. That Sec. 34-11.1 of the Code of the City of Lynchburg, 1981, be and the same is hereby amended and reenacted as follows:

Sec. 34-11.1. Unpolluted waters prohibited in sanitary sewers.

(a) It shall be unlawful for any person to discharge or cause to be discharged to the sanitary sewer any unpolluted waters such as storm water, ground water, roof runoff or subsurface drainage.

(b) All existing connected rainleaders are to be removed from the sewer system according to the council-adopted policies and guidelines entitled "Rainleader Disconnect Program". Reconnection of rainleaders to the sewer, without prior permission from the program administrator, will not be allowed. For purposes of this section a rainleader shall be defined as any conduit that conveys stormwater into the city sewer lines. A copy of the "Rainleader Disconnect Program" policies and guidelines shall be kept in the office of the department of public works and shall be available for review upon request. Any persons reconnecting rainleaders once a disconnect is completed, will be in violation of the provisions of this section and shall be guilty of a class 1 misdemeanor. Whenever a rainleader is reconnected it shall be presumed that the reconnect was done by or with permission of the property owner; provided, however, that such presumption shall be rebuttable by competent evidence.

2. That this ordinance shall become effective upon its passage.

Adopted: April 23, 1996

Certified:

Cathleen W. Kest
Clerk of Council

A-59.2

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ENGINEERING & TRAFFIC

cc: R. A. Booth
W. C. Erwin
L. D. Johnson
J. B. Martin
~~T. Reid~~



RAINLEADER DISCONNECT PROGRAM
POLICIES AND GUIDELINES

APRIL 26, 1996

Rainleader Disconnect Policy

All existing *connected rainleaders* (residential and non-residential) are to be disconnected prior to the completion of the *CSO control plan*. If a disconnection is not cost effective, a *waiver* will be granted by the City. *Disconnected rainleaders* may not be reconnected to the City sewer system.

Disconnect Program

To support the City's *rainleader* disconnection policy, a Rainleader Disconnection Program (RDP) will be implemented. The goal of the program is to eliminate 75% of stormwater from existing connected rainleaders. This program will consist of four different phases:

Phase 1) A City-wide Volunteer Disconnection Phase consisting of public information activities directed to all residents during a period of 18 months. These activities are intended to motivate residents of *CSO separation areas* to voluntarily disconnect their rainleaders

Phase 2) A CSO Separation Area Volunteer Disconnect Phase with follow-up to city-wide communications to residents of CSO separation areas in conjunction with individual separation projects. This phase is designed to continue voluntary disconnection activities.

Phase 3) City-contracted Disconnect Phase for the remaining connected rainleaders will include direct involvement between property owners and private contractors hired by the city. These contractors will contact individual property owners to develop a disconnection method which is acceptable to the owners and to the City.

Phase 4) An Enforcement Phase will include a *treatment charge* to be applied to property owners who do not participate in the rainleader disconnect program.

Program Implementation

The City-wide Volunteer Disconnect Phase will consist of the following elements:

1) Media advertising and publicity will be directed to all city residents. An introductory period will be followed by maintenance promotional activities during the course of the program.

2) All *combined sewer areas* will be divided into nine different geographic sectors of approximately 1000 structures each in order to facilitate volunteer response during the 18-month city-wide program. Residents of these sectors will be contacted using direct mail and door-bag materials. Public meetings will provide an opportunity for property owners to receive answers to specific questions and to receive disconnection instruction. Several areas already involved in CSO separation can not be offered the citywide volunteer disconnect program because of time constraints. These owners will be offered a full range of disconnect options during their CSO Separation Area Volunteer Phase.

The owner of each property will receive a payment of \$150/rainleader for disconnecting connected rainleaders provided that all connected rainleaders per property are disconnected. Property owners will be given three months to volunteer plus another three months (a total of six months) to complete disconnects.

To participate in this program, property owners must call or mail a response to a designated city representative. The representative will initiate a brief

inspection of the structure's rainleaders to determine which rainleaders are connected. Property owners will be informed of the status of their rainleaders and provided with instructional materials.

They will be advised to notify the City's designated representative upon completion of the disconnections so that verification can be made. Upon verification, payment will be made to the property owner within 60 days. A training program, conducted by the City, will be offered to individuals, civic groups, and charitable organizations, to educate them on disconnection methods.

A CSO Separation-Area Volunteer Disconnect Phase will begin approximately six months prior to starting the design of each separation project and consist of the following elements:

- 1) Notification of property owners affected by construction via direct mailings, door bag announcements, and public meetings.
- 2) A volunteer disconnect option will again be offered and will require that all connected rainleaders on a property be disconnected. For each *Level One* rainleader that is disconnected, the property owner will receive a payment equal to $\frac{1}{2}$ (rounded to the nearest \$10 increment) of the upper cost limit for Level One rainleaders. As of July 1, 1996 this payment will be \$150/rainleader.
- 3) In addition to the payment offered for Level One rainleaders, owners will be asked to obtain cost estimates for *Level Two* rainleaders to obtain full payment or a waiver. These estimates must come from a *certified contractor*.

The City-contracted Disconnect Phase provides for the disconnection of all connected rainleaders which were not voluntarily disconnected. This phase includes the following elements:

- 1) City-certified contractors will be assigned to contact property owners to work out individual disconnection plans.

- 2) Contractors will document cost estimates for Level Two rainleaders. *Waivers* will be granted for rainleaders that are not cost effective.
- 3) Contractors will disconnect all remaining connected rainleaders that are cost effective to disconnect.
- 4) Contractors will be paid by the City for actual cost incurred.

The Enforcement Phase will include a treatment charge which may be assessed to any property owner who refuses to disconnect a connected rainleader. Exceptions are connected rainleaders which are determined not to meet cost criteria. This charge may be applied, if necessary, to achieve the goals of the rainleader disconnect program. This treatment charge will be billed annually to individual property owners. Upon verification from the City, the owner may stop this charge by disconnecting the rainleader upon verification by the City. The *program administrator* will routinely submit a progress report to City Council detailing the number of properties which fit the treatment charge criteria to determine when and if a treatment charge is to be applied.

Definitions

Certified Contractor - A contractor that is certified by the City as having met certain skill, experience, and training criteria related to the type of work associated with rainleader disconnection.

Certified Disconnection Plan - A plan prepared by a licensed design professional (engineer, land surveyor III-B, or landscape architect) that indicates how rainleaders will be disconnected, where the water will be discharged, and what impact the discharge will have on receiving channels or areas. This plan is to be reviewed and approved by the program administrator or designee prior to the disconnection work taking place.

City-Contracted Disconnection - Disconnection of rainleaders by a certified contractor, paid by the City, working under the direction of the program administrator or designee.

Connected Rainleader - A conduit that conveys stormwater to the City's combined sewers.

Combined Sewer - A sewer that conveys both sewage and stormwater.

Combined Sewer Area - The portion of the City that contains combined sewers.

Combined Sewer Overflow (CSO) - The City's combined sewers are inadequate to convey the combined sewage and stormwater flows to the wastewater treatment plant during heavy rainfall events. The excess flow discharges from the combined sewers into nearby streams.

Cost Effective Disconnect- A rainleader will be considered cost effective to disconnect if the cost to disconnect does not exceed a specified cost per square foot of impervious area draining to the rainleader. This specified cost is based on the cost to treat the average annual precipitation (41.88" = 3.41 c.f./s.f./year) entering the rainleader for a period of 20 years (the projected duration of the CSO Control Plan). This specified cost will be adjusted whenever sewer rates change. As of July 1, 1996 the sewer rate will be \$0.0301/c.f.. At that time, rainleaders costing less than \$2.05/s.f. to disconnect will be cost effective.

$$(20\text{years}) \times (3.41\text{c.f./s.f./year}) \times (\$0.0301/\text{c.f.}) = \$2.05/\text{s.f.}$$

For a typical rainleader draining 300 s.f., the cost effective disconnection cost will be \$615 or less.

CSO Control Plan - The plan adopted and implemented by the City of Lynchburg to eliminate its combined sewer overflow problems. The three programs of the plan are sewer separation, interceptor sewer replacement, and rainleader disconnection.

CSO Separation Program - Construction of new sewers and rehabilitation of existing sewers for the purpose of eliminating combined sewers. In most cases, stormwater will

be routed to the new sewers and sewage will continue to be conveyed by the rehabilitated sewers.

CSO Separation Area - Any of the small drainage basins containing combined sewers identified in the CSO Control Plan.

Disconnected Rainleader - A rainleader that has been permanently modified so that it no longer conveys stormwater to the City's combined sewers.

Impervious Area - Surface areas such as rooftops, asphalt, concrete, etc. that do not allow water to easily penetrate.

Level One - The cost of materials and labor to disconnect an individual rainleader is less than (150) X (cost effective disconnection rate/square foot). This figure will be adjusted as sewer rates change. As of July 1, 1996 this figure will be \$307.50.

Level Two - The cost of materials and labor to disconnect an individual rainleader is equal to or greater than (150) X (cost effective disconnection rate/square foot). This figure will be adjusted as sewer rates change. As of July 1, 1996 this figure will be \$307.50.

Program Administrator - The program administrator shall be the Director of Public Works or designee. Primary duty shall be coordination of, and responsibility for, Rainleader Disconnection Program efforts by City personnel and consultants.

Property Owner - The fee-simple legal title holder of a real estate parcel.

Rainleader - A rainleader is any conduit that conveys stormwater.

Rainleader Disconnection Program (RDP) - A comprehensive plan which provides for the disconnection of rainleaders that are connected to the City's combined sewers.

Sanitary Sewer - A sewer that conveys liquid wastes generated by residences, businesses, and industries.

Storm Sewer - A sewer that conveys surface drainage from springs, rain, melting snow, etc..

Treatment Charge - A charge assessed against any property whose owner does not allow the disconnection of rainleaders that are cost effective to disconnect. This charge will be based on the cost to treat the flow entering the sewer system from those connected rainleaders. This charge will be adjusted as sewer rates change. As of July 1, 1996 the sewer rate will be \$0.0301/c.f. and the minimum charge will be \$30.79/year/rainleader (based on a typical rainleader that drains 300 square feet and the average annual precipitation of 3.41 cubic feet per square foot). The charge for rainleaders draining more

than 300 square feet will be based on actual drainage area.

Waiver - A permanent exemption from being required to disconnect. A waiver shall be granted for any rainleader that is not cost effective to disconnect. The treatment charge will not be assessed against rainleaders that have been granted a waiver.



Amendments to the Rainleader Disconnect Program
Policies and Guidelines

February 22, 2011

Amendments to the 1996 Rainleader Disconnect Program

These amendments will only be applied in situations where full disconnection of rainleaders cannot be reasonably achieved, as determined by City staff. The maximum reimbursement will be determined through completion of the appropriate Urban Disconnect Calculator as provided by the City. Examples of each Calculator are attached in Appendices A and B. The calculations submitted via the Urban Disconnect Calculators will be subject to review and approval by City staff, and are for planning purposes only. They do not take the place of design drawings nor do they take the place of any other review, permit or construction requirements. The Calculators in Appendices A & B are for Infiltration Basins, Infiltration Trenches, Rain Gardens, Ponds, or Underground Storage BMPs. Other types of BMPs must be specifically reviewed and approved by City staff. An example calculation for a rain garden is provided in Appendix C.

Under this amendment, the maximum reimbursement will be determined based on the rooftop area treated multiplied by the reimbursement rate. The reimbursement rate will be calculated as defined in the 1996 RDP Policy, pro-rated based on the percent reduction in peak flows achieved by the BMP. For example a sewer rate of \$5.54/hcf equates to a reimbursement rate of \$3.78/sf with full disconnection. If the proposed BMP reduced peak flows by 75%, then the reimbursement rate would be reduced by 25% to \$2.84/sf. Thus a 1,000 sf roof would qualify for a maximum reimbursement of $1,000 \text{ sf} \times \$2.84/\text{sf} = \$2,840$.

Calculation Assumptions

The City's current CSO model is based on seven theoretical storm events that vary in duration and range from 0.055 inches to 2.81 inches per storm event, and are used to calculate the annual overflow volume as reported to the VADEQ. These storm hyetographs are attached in Appendix D. The Urban Disconnect Calculators incorporate these seven hyetographs as the basis for determining the maximum reimbursement.

Runoff Assumptions:

1. T_c – Time of concentration, T_c , can be neglected. The minimum T_c for normal design computations is 5 minutes. The runoff from a roof is much more rapid than 5 minutes; therefore, it can be assumed that the concentration time would be instantaneous.
2. SCS Curve Number – The curve number for a roof is typically 98. This number signifies the amount of water that will runoff from its original location. To simplify the calculations, the SCS Curve Number was ignored and it is assumed that all runoff will enter the detention basin. This provides for a slightly conservative runoff estimate.
3. Hydrologic Time Interval - The supplied hyetographs from the City are in hour increments. When using software to calculate hydrographs, the hydrological time interval should be set to one minute intervals.

4. Storm Distribution Type - The distribution type for these calculations are custom as provided by the Department of Environmental Quality (DEQ.)

Detention Facility Assumptions:

1. Infiltration Rate of Media – The infiltration rate will be based on the values stated in the Virginia Stormwater Management Handbook (VSMH), Table 3.10-2. Note that the natural soil should never be used within the mixture due to this region’s high clay content.
2. Media Depth - For rain gardens, infiltration basins and infiltration trenches, the media depth shall be assumed to be the maximum depth of 30 inches as stated by the VSMH pg. 3.11-13.
3. Free Board - The maximum ponding depth above the media for rain gardens, infiltration basins or infiltration trenches with underdrains. Heavier rains that cannot be drained through the media will leave the site by some other means, such as a riser or flume.
4. Media porosity - The media porosity shall be based on the type of soil selected for the BMP as per the Department of Agriculture Bulletin 462, or as determined by field testing.
5. Inflow Locations - It is assumed that the runoff will be distributed evenly across the entire facility.
6. Soil Field Capacity - The BMP media will be assumed to absorb water at a rate identical to the infiltration rate of the soil. This is used to reflect that the media will hold a certain amount of runoff prior to releasing storm water. (Dept. of Agriculture Bulletin 462, 1960)

Appendix A

Urban Disconnect Calculator for Rain Gardens, Infiltration Basins, or Infiltration Trenches

Appendix B
Urban Disconnect Calculator for Ponds or Underground
Storage

Appendix C
Sample Calculation for a Rain Garden

An example of a rain garden facility is summarized below:

Roof area to be disconnected:	8,500 sf
Basin Dimensions:	10 ft x 30 ft
Basin Area:	300 sf
Basin Media Depth:	2.5 ft
Underdrain:	30 lf – 4 in perforated pipe with 8 in No. 57 stone
Free board:	1.0 ft to top of riser
Media porosity:	30 percent
Storage volume over media:	$(300 \text{ sf} \times 1.0 \text{ ft}) = 300 \text{ cf}$
Storage volume in media:	$(300 \text{ sf} \times 2.5 \text{ ft})(0.30) = 225 \text{ cf}$
Infiltration rate:	2.0 in/hour (hr)
Soil Field Capacity:	$(2 \text{ in/ft}) \times (2.5 \text{ ft}) \times (300 \text{ sf}) \times (1 \text{ ft}/12 \text{ in}) = 125 \text{ cf}$

Analysis of rain garden design

1. Check flow through media:

$(\text{Infiltration rate}) \times (\text{basin area}) \times (\text{media porosity}) = \text{flow through media}$

$$[(2 \text{ in/hr}) / (12 \text{ ft/in})] \times (300 \text{ ft}^2) \times (0.30) = 15 \text{ cf/hr}$$

2. Check flow into perforations in pipe:

Use orifice equation

$$Q = ca\sqrt{2gh}$$

Q = flow rate, cfs

c = slot constant (assumed to be 0.61)

a = slot opening area, ft^2

g = acceleration due to gravity (32.2 ft/s^2)

h = head, ft

Perforated pipe openings = $1.9 \text{ in}^2/\text{ft}$

Pipe length = 30 ft

Opening area = $(30 \times 0.0132 \text{ ft}^2) = 0.396 \text{ ft}^2$

$$Q = (0.61)(0.396)\sqrt{2(32.2)(2.5)} = 3.07 \text{ cfs} = 11,034 \text{ cf/hr} > 15 \text{ cf/hr}$$

3. Check flow through 4 inch pipe using Manning's equation:

$$Q = a \left(\frac{1.49}{n} \right) R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$a = 0.087 \text{ ft}^2$

$n = 0.022$

$S = 0.005$

$p = 1.046 \text{ ft}$

$$R = \frac{a}{p} = \frac{0.087}{1.046} = 0.083$$

$$Q = (0.087) \left(\frac{1.49}{0.022} \right) (0.083^{\frac{2}{3}}) (0.005^{\frac{1}{2}}) = 0.079 \text{ cfs} = 285 \text{ cf/hr} > 15 \text{ cf/hr}$$

The detention facility component that is the most restrictive to water flow is the sand/soil media mixture. In smaller rain events the media will absorb the rainfall. In this example, the media's field capacity is 125 cf of water. In larger rain events the media would not be able to handle the runoff in which case the storm would eventually reach the riser structure. Flows that are smaller than 125 cf will not reach the underdrain or outfall.

The results from the Urban Disconnect Calculator for this example are listed in Table 1 below.

Table 1. Results from the Urban Disconnect Calculator for a rain garden

	Storm A 0.055 in	Storm B 0.172 in	Storm C 0.405 in	Storm D 0.702 in	Storm E 1.027 in	Storm F 1.586 in	Storm G 2.81 in
Peak Flow, existing conditions, cf/hr	26.21	64.46	130.33	196.21	264.92	307.42	403.75
Peak Flow with Raingarden, cf/hr	0.00	0.50	15.00	15.00	91.96	214.21	402.92
Reduction, cf/hr	26.21	63.96	115.33	181.21	172.96	93.21	0.83
Percent Reduction	100.0%	99.2%	88.5%	92.4%	65.3%	30.3%	0.2%
Occurrence per Year, %	27.1%	20.6%	25.9%	11.3%	7.5%	4.9%	2.7%
% Yearly Rainfall Volume	3.2%	7.6%	22.5%	17.1%	16.6%	16.7%	16.3%
Weighted Percentage Reduction	3.20%	7.54%	19.91%	15.79%	10.84%	5.06%	0.03%
Simple Average Percent Reduction	68%	Simple Average Calculation $\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^n x_i$					
Weighted Average Percent Reduction	62%	Weighted Average Calculation $\bar{x} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i}$					

Summary

The simple average peak runoff for this site would be 68 percent; however, this average does not take into account the frequency of each type of storm event nor the total runoff volume for each storm throughout a year. For example, Storm D will produce a total rainfall amount of 0.702 inches per storm event and Storm G will produce 2.81 inches per event. If these storms only happened once per year, then a simple average would be logical. Since this is not the case, and larger storms occur less frequently than smaller storms, the frequency of each storm must be taken into account when calculating the percent reduction. A Weighted Average Percentage Reduction (WAPR) factor, as shown in the table above, should be used to calculate a site's overall peak flow reduction rate for reimbursement. Thus, the rain garden in the above example reduced peak flows an average of 62 percent. Thus, the maximum reimbursement would be 62 percent of \$3.79/sf, or \$2.35/sf. Based on the rooftop area of 8,500 sf, the maximum reimbursement for the constructed rain garden would be \$19,975.

Appendix D
CSO Design Storm Hyetographs