

THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT  
Silco Oil Building, 181 East 56th Avenue, Denver, Colorado 80216. Telephone: (303) 534-0105

## ENGLEWOOD FORGES AHEAD

By KELLS WAGGONER

*Director of Public Works, City of Englewood*

For many years, Englewood, like most other communities, has had inadequate storm drainage systems or none at all. We had several storm drainage plans which covered the entire community, but there was never enough money to instigate the program.

In early 1970, Englewood realized that its "1961 Drainage Report" was outdated in cost estimates, and because the Urban Drainage Manual was outdated in design, a consulting firm was retained to update our storm drainage plan.

During the report phase, the Englewood City Council was exploring methods of financing storm drainage installations. After considering several alternates, it was decided, in September, 1971, to increase the sales tax by one percent and to place the total amount of monies received from the increase into the Public Improvement Fund. Storm drainage was high on Council's priority, and therefore, has received the "lion's share" in the appropriations.

1970 - \$ 100,000
1971 - 710,000
1972 - 1,556,860 - (1) Storm Drainage
279,800 - (2) Drainage, Greenbelt & Park
1973 - 1,657,000
221,000 - Detention Pond & Park
1974 - 1,000,000 - Proposed
Total \$5,524,660

- (1) \$556,860 was a Federal Grant.
- (2) \$139,900 was a Federal Grant.

The report phase required that Englewood adopt some storm drainage criteria to be used in design. Following is that criteria:

### Storm Drainage Criteria Adopted By The City of Englewood

Storm Return Period:	Minor Storm	Major Storm
Commercial areas	5	100
Residential and Industrial areas	2	100

### Allowable Use of Streets as Carriers of Runoff from a Minor Storm:

Street Classification	Maximum Encroachment
Local	No curb overtopping. Flow may spread to crown of street.
Collector	No curb overtopping. Flow spread must leave at least one lane free of water.
Arterial	No curb overtopping. Flow spread must leave at least one lane free of water in each direction. No flow in crosspans is permitted across the street.
Freeway	No encroachment is allowed on any traffic lanes. No flow in crosspans is permitted across the traffic lanes.

### Allowable Use of Streets as Carriers of Runoff from a Major Storm:

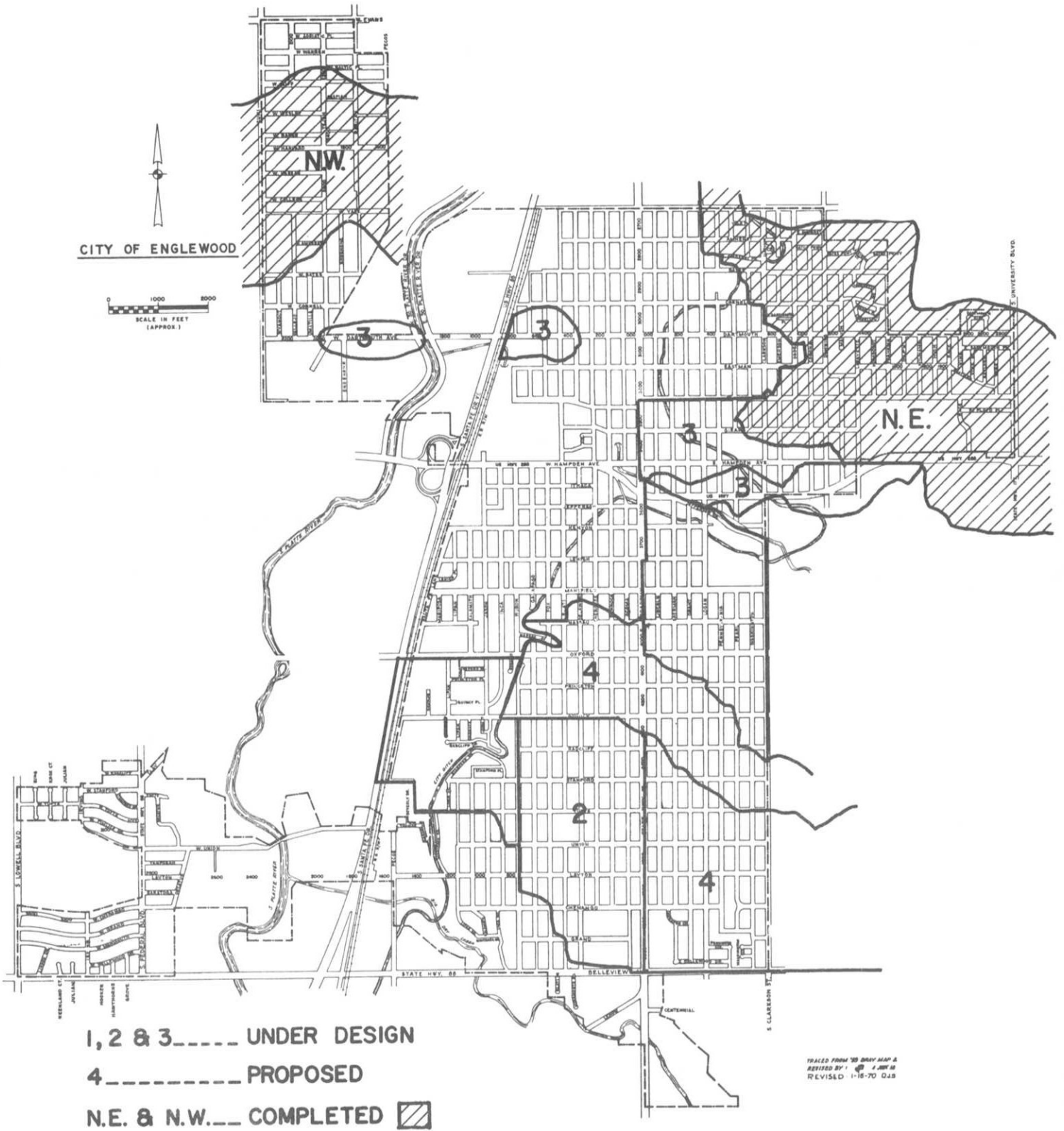
Street Classification	Allowable Depth and Inundated Areas
Local and Collector	Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line unless

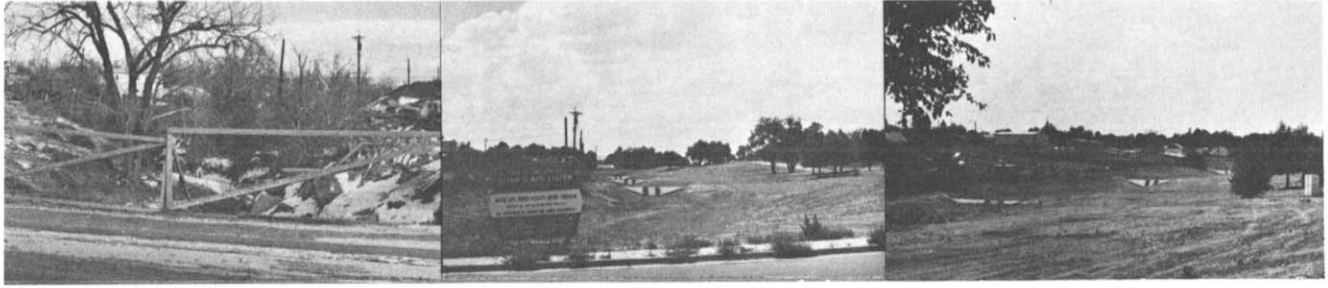


Kells Waggoner is a graduate of the University of Wyoming (cum laude) and a native of the Buffalo-Clairemont area of Wyoming. He has been with the City of Englewood since 1964, and prior to that was Assistant City Engineer in Casper, Wyoming. He is a member of N.S.P.E., A.P.W.A., and holds a Registered Professional Engineer's license in Colorado, and is a Registered Professional Engineer and Land Surveyor in Wyoming.



# STORM DRAINAGE PROGRAM





NORTHWEST ENGLEWOOD: Before and after pictures show a gulch that was an unsightly flood hazard. Note the drop structures. Area is to become a public park. This is one of several multi-jurisdictional undertakings supported by Federal grants.

## Englewood Forges Ahead

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buildings are flood proofed. The depth of water over the gutter flowline shall not exceed 18 inches.

### Arterial and Freeway

Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line unless buildings are flood proofed. Depth of water at the street crown shall not exceed 6 inches in order to allow operation of emergency vehicles. Depth of water over the gutter flowline shall not exceed 18 inches.

### POLICY RECOMMENDATIONS

The report, which was finished in January, 1971, recommended future storm drainage policies in order to insure that the level of storm drainage protection proposed would be maintained. Those policy recommendations are as follows:

1. The storm drainage system must be integrated into the master plan for the development of the City. This is particularly important with regard to the restoration of adequate major drainage facilities.
2. Natural waterways should not be restricted. Those waterways which have been obscured should have their natural hydraulic capacities restored if at all possible. Also, natural pond or lake areas should not be built in or created unless provisions are made for the collection and proper conveyance of runoff from a major storm. In this regard, it is recommended that the City initiate a program of accurately defining the limits of flooding along the routes of overland flow of a major storm runoff. It is also recommended that a flood plain regulation policy be formulated which would eventually eliminate the possibility of serious property damage from major storm flooding.
3. No storm drainage improvement should be made which transfers a drainage problem from one point to another. In this regard, any instance of diverting water from its natural path must in no way make an area vulnerable to flooding which was not previously endangered.
4. No upstream developer or municipality should be allowed to make improvements which will cause more

runoff than would have naturally occurred under previously existing land use. In this regard, temporary or permanent storage of storm water or other methods of reducing or detaining flood peaks should be encouraged. The recommendations are based on the forecast 1990 land use. Proposed developments which would increase the runoff over that predicted herein should not be permitted.

5. Developers, owners, and prospective owners of property vulnerable to flooding and particularly property which is in an obscured natural waterway should be made aware of the flood danger. The owners of exposed properties should be encouraged to undertake flood proofing measures until flood hazards are eliminated.
6. The use of streets and alleys as drainage facilities must, under normal conditions, be secondary to their primary function, which is traffic movement.
7. All street systems should be designed in such a way that a continuous grade toward a major drainage facility is maintained. This insures that major storm flows will primarily follow streets rather than accumulate in mid-block residential or commercial areas.
8. All storm drainage facilities must be kept clear of debris and in proper operating condition. The City could be held liable for flood damage attributable to inadequate maintenance.
9. Irrigation ditches should not be used or relied upon for storm drainage functions unless they are properly analyzed and maintained and the points and consequences of overflow are known.

### NORTHWEST ENGLEWOOD IMPROVEMENT

Upon completion of the report, the City Council authorized the engineers to begin design in the Northeast and Northwest Englewood areas, and also authorized the application for a Federal grant. Both areas are multi-jurisdictional, and with the cooperation of the Urban Drainage District and the City and County of Denver, we were able to bring the project to reality. A Federal grant was obtained, work begun, and the project is now almost completed. Denver's contract amount in the Northeast area is \$184,965, of which \$88,540 is part of the Federal grant mentioned above.

The Northwest Englewood area was traversed by an unsightly, deep, debris-filled gulch which was almost impossible for the private owners to clean. This gulch is on the lower end of Denver's Neighborhood Development

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# DRAINAGE MASTER PLANS

By D. J. "JACK" GIANOLA

*Civil Engineer, Urban Drainage and Flood Control District*

One important activity of the Urban Drainage and Flood Control District involves coordinating and managing the development of Drainage Master Plans for selected drainageways to overcome or minimize serious flood hazards.

Each year the District contacts each of the 33 entities within its boundaries, asking which drainageways within their respective jurisdictions are presenting the most serious drainage problems. After the requests have been reviewed and the relative costs estimated roughly, the District determines the ten or twelve priority drainageways to be master planned. These projects become the Work Program for the District during the coming year.

In order to qualify for master planning, a drainageway has to pass through two or more governing jurisdictions. In other words, the drainage problems have to be multi-jurisdictional in nature, presenting problems that cannot be solved without the cooperation and financial support of all the jurisdictions involved.

The procedures followed in the development of a Drainage Master Plan can be divided into several stages, as described below.

## NEGOTIATIONS

The negotiation process involves obtaining the verbal or written commitment of money by each of the jurisdictions involved. Usually the District's Engineer or other representative makes a scheduled appearance before City Councils or County Commissioners to explain the function of the District and the advantages of master planning to solve drainage problems.

After money has been committed by each jurisdiction, a rough draft of an agreement is written by the District calling for employment of a consulting engineer to develop the master plan. Each entity has the opportunity to review the draft agreement and to incorporate therein any ideas or comments to assist in solving drainage problems along the drainageway within the affected communities. Next, the local jurisdictions and the District select a consulting engineer to develop the drainage master plan.

The engineer designated then negotiates with the District with regard to the fee, scope of services, and the incorporation of any new ideas or comments any of the participating parties may have offered to improve the agreement.

When negotiations with the engineer have been completed, the final agreement is written by the District and transmitted to each concerned party for authorized signatures. Upon completion of all authorized signatures, the project is under way.

Also, included in the negotiation stage is the selection of a mapping firm by the District to perform the necessary topographic mapping for use by the consulting engineer. The financial responsibility for this mapping is that of the District.

## PHASE A:

Phase A is the second step undertaken in the develop-

ment of a drainage master plan. The engineer has to meet initially with the local jurisdictions to obtain all existing data and general information, to solicit desires in order to develop alternate plans, and to procure current information relative to development plans within the drainage basin. Contact is made with any other federal, state, or local government having knowledge and an interest in the drainage basin.

Next come hydrological studies for three recurrence intervals, for present and future development. These studies are performed in sufficient depth and detail to determine the peak rate of runoff and volume of runoff for the basin and each sub-basin in order to develop plans on a dependable hydrologic basis.

The engineer then evaluates all possible alternates on a reach-by-reach basis which might provide alleviation to the existing flood hazard problems associated with the drainage basin. The best three alternate plans are presented schematically on topographic base mapping. The three best alternates then are reviewed by an attorney who is an expert in the Colorado drainage law.

Finally in Phase A the engineer conducts a benefit-cost analysis showing the benefit-cost ratios for the improvements for each jurisdiction which enable the local jurisdictions and the District to balance the monetary cost and benefits.

The completed product of Phase A is an interim report explaining all the above mentioned items in enough detail in order that the District and the local jurisdictions can make a selection of the most advantageous, economical, and efficient alternative offered.

## PHASE B:

Phase B is the preliminary engineering design of the selected alternative. The preliminary design is conducted in adequate detail to permit the District and the local jurisdictions to properly plan bridges and culverts for new vehicular thoroughfares, the acquisition of needed channel right-of-way, and to permit the planning of new subdivisions and buildings with full knowledge of future channel and flood plain locations and characteristics.

The engineer also prepares itemized cost estimates separated to the extent of identifying the cost of facilities relating to drainage, park development, and street crossings.

Phase B yields a report that consists of two volumes; one contains narrative description, and the other contains plan and profile drawings of the drainage improvements.

## FINAL DESIGN:

Final design of a drainage master plan is the actual preparation of drawings and specifications to be used for construction. The negotiations for final design are similar to those in Phase A, with the emphasis being placed on commitment for larger sums of money by the District, by State and/or Federal Government, and by the local jurisdictions, to finance actual construction of the project.

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# Status of Drainage Master Plans

## URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

Drainage Basin	Jurisdiction	Engineer	Status
Sanderson/Weir Gulches	Denver, Lakewood	Frasier & Gingery, Inc.	Completed
Big Dry Creek	Adams County, Westminster, Jefferson County	Wright-McLaughlin Engineers	Completed
Henry's Lake	Jefferson County, Lakewood	Leonard Rice Consulting Water Engineers	Completed
West Toll Gate Creek	Aurora, Arapahoe County	Corps of Engineers	Final stages
South Boulder Creek	Boulder, Boulder County	R. W. Beck & Associates	Under way, Phase B
Little Dry Creek	Englewood, Cherry Hills Village, Greenwood Village, Arapahoe County, Douglas County	McCall-Ellingson, Inc.	Under way, Phase B
Niver Creek	Adams County, Thornton, Federal Heights	Engineering Consultants Inc.	Under way, Phase A
Goldsmith Gulch	Denver, Greenwood Village, Arapahoe County	Frasier & Gingery, Inc.	Under way, Phase A
Brighton Drainage Basin	Brighton, Adams County	Nelson, Haley, Patterson and Quirk, Inc.	Under way, Phase A
Lena Gulch	Wheat Ridge, Lakewood, Jefferson County, Golden	Wright-McLaughlin Engineers	Under way, Phase A
Highline Canal	Denver Water Board	Leonard Rice Consulting Water Engineers	Under way
Lakewood/McIntyre Gulches	Denver, Lakewood, Jefferson County	McCall-Ellingson, Inc.	Negotiation stage
First Creek	Adams County, Aurora, Arapahoe County	Engineering Consultants, Inc.	Negotiation stage
Big Dry Creek (Arapahoe County)	Englewood, Littleton, Greenwood Village, Arapahoe County, Douglas County	VTN Colorado, Inc.	Negotiation stage
Grangehall Creek	Adams County, Thornton, Northglenn	Drexell, Barrell & Co.	Negotiation stage
Westerly Creek	Denver, Aurora, Arapahoe, County, Lowry Air Force Base	_____	Negotiation stage
Boulder and South Boulder Creeks	Boulder, Boulder County	_____	_____
Van Bibber Creek	Arvada, Jefferson County	_____	_____
Basin 4309	Denver, Wheat Ridge, Jefferson County, Mountain View, Lakeside	_____	_____
Englewood Dam	_____	Woodward-Clevenger and Associates	Completed
Sanderson Gulch Final Design	Denver, Lakewood	_____	Negotiation stage

# Tucker-Talk

by L. SCOTT TUCKER

*Timely Comment from the District's Executive Director*



## FLOOD INSURANCE

The unincorporated areas of Jefferson County were recently added to the list of qualified areas for HUD subsidized flood insurance. The insurance is effective as of July 5, 1973 at subsidized rates on an emergency basis. The land use and control measures submitted by Jefferson County were accepted by HUD pending a detailed examination.

## CHANGES PROPOSED

Substantially larger — and stricter — flood insurance is proposed in H.R. 6524, now being considered by the House Banking and Currency Committee under the sponsorship of Mr. Patman and other Members of the U.S. Congress. Following the record-breaking floods earlier this year, the Act would:

“(1) Substantially increase the limits of coverage authorized under the national flood insurance program; (2) provide for the expeditious identification of, and the dissemination of information concerning, flood-prone areas; (3) require States or local communities, as a condition of future Federal financial assistance, to participate in the flood insurance program and to adopt adequate flood plain ordinances with effective enforcement provisions consistent with Federal standards to reduce or avoid future flood losses; and (4) require the purchase of flood insurance by property owners who are being assisted by Federal programs or by federally supervised, regulated, or insured agencies in the acquisition or improvement of land or facilities located or to be located in identified areas having special flood hazards.”

The proposed law has ample “teeth” to prevent nearly all residential or commercial construction on identified flood plains, by preventing financing or re-financing of structures in such locations by Federally-insured banks, savings and loan associations and other agencies in any way related to the Federal government unless the property is covered for the full loan value by Federal insurance. The bill does not prevent building on a flood plain, but instead requires the property have flood insurance, if Federal help is wanted in the event there is extensive flood damage there.

Known flood-hazard and flood-risk zones have already been identified and mapped in many areas, as in the Upper South Platte River drainage basin for which flood plain maps are available covering the various streams and gulches in the Denver and suburban areas. The new bill would speed up such identification and mapping in other parts of the United States where there is a history of floods causing extensive damage and/or loss of life.

The proposed bill would increase to \$35,000 aggregate liability for any single-family dwelling, and \$100,000 for any residential structure containing more than one dwelling unit. Other substantial increases would be made for property in other categories, as well as for contents of insured structures.

## ENGLEWOOD DAM

The Board of Directors of the Urban Drainage and Flood Control District at a special meeting May 23, 1973 agreed to accept responsibility for Englewood Dam. The Board determined that in the absence of an expressed desire by any of the local entities involved to own the dam, the District would accept ownership of the dam by transfer of title from the current private owner. The Board also committed \$400,000 of District funds for improving the dam to meet standards defined by the State Engineer.

The State Legislature appropriated \$20,000 for the Englewood Dam Project and the City of Englewood recently committed \$300,000. The remaining \$100,000 of funds needed to improve the facility are to come from Arapahoe County, Cherry Hills Village and Greenwood Village.

## CAPITOL IMPROVEMENTS EXPENDITURE POLICY

The Board of Directors at the June meeting adopted a capitol improvements expenditure policy for the .4 of a mill levy allocated for construction of drainage and flood control projects. The Board adopted the policy of allocating its available funds for drainage and flood control improvements in such manner that 5-year tax revenues received from counties within the District will be spent for improvements benefitting those counties. The Board declared they will approve specific drainage and flood control projects using the following criteria in establishing priorities:

- a. The proposed improvement has been requested by local public bodies;
- b. The proposed improvement has been master planned or preliminarily planned so as to adequately estimate the cost and benefits of the improvement;
- c. The local public bodies have indicated a willingness and readiness to share in one-half of the total cost of the improvement after subtracting the State, Federal, or other sources of funding, excluding any contribution from the Urban Drainage and Flood Control District; and
- d. The local public bodies have agreed to enter a maintenance agreement for the completed improvement in a form acceptable to District.

## FLOODING CONTINUES

Flooding continues to be a problem in the Denver region. A short duration high intensity storm in the Lakewood area in early June sent waters rushing through Lakewood and Edgewater into Sloans Lake. Two boys fell into a drainage ditch and were swept into an underground conduit and were drowned. This was a very isolated rainfall event and it illustrates how one drainage basin can receive a great amount of rainfall while others around it receive relatively little precipitation.

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## Englewood Forges Ahead

(Continued from Page 3)

Program in the College View area, and Denver had already turned its portion into a landscaped park area.

Englewood continued the plan by buying one tier of lots for a quarter-mile and a greenbelt strip for another quarter-mile. The design incorporated a pipe which would carry the two-year flow, and a drainage swale which would carry the 100-year flow. The area has three drop structures which blend into the background, and the area will be grassed, sprinklered and developed as a total park facility.

### PROTECTING NORTHEAST ENGLEWOOD

The Northeast Englewood area consists of a gentle swale where buildings have almost obliterated the natural drainage-way. Runoff water from Arapahoe County, Cherry Hills Village, and Denver, enters Englewood at Floyd Avenue and University Boulevard, traverses northwesterly through Englewood, and enters Denver at Yale and Washington, then enters Harvard Gulch at approximately Harvard and Pearl. This area was designed with a pipe system capable of carrying the two-year-design storm.

A portion of this area was virtually a ponding place where houses had been built without facilities for the natural runoff of water. In this particularly critical situation, a five-year design was incorporated. A development on a 55-acre site within this drainage course was required to provide a detention pond area capable of handling the difference between a 100-year-design storm and the two-year-design storm, and to dedicate this area as a public park. The park will have controlled-outlet structures so that we will not overload our system, but will be able to drain the detention pond at a faster rate once the storm has passed.

### OTHER PROJECTS DEVELOPING

With more monies available, the Council authorized design of storm drainage facilities in the South Englewood area (numbers 1 & 2 on the map) and in several smaller basins (number 3's) where severe flooding exists.

In area number one (1), four houses and some undeveloped land will be purchased in order to provide a detention pond so that the size of the outfall line can be decreased.

In area number two (2), twenty houses will be purchased in order to provide a drainage channel and greenbelt park; the decision to open up the old natural channel was based on the fact that the channel was well-defined and pipe would not keep the buildings from being flooded during heavy rainfall.

Because of the critical nature of some of the area 3's, the design will incorporate the five-year flows. The contracts on these areas are expected to be awarded during November or December of this year.

The areas shown on the map with the number 4 will be the next order of priority, and it is expected that design will be authorized before the end of the year, with money budgeted for completion during 1974.

With the completion of all of the above-mentioned areas, Englewood will still have approximately \$3 million worth of storm sewer to install to complete our master plan. Hopefully, Council and the citizens of Englewood will continue in the same manner that we have recently.

Englewood has obligated itself for \$300,000 toward the rehabilitation and updating of the Englewood Dam as a flood protection measure on Little Dry Creek. This was done in cooperation with the Urban Drainage and Flood Control District, Arapahoe County, Greenwood Village, and Cherry Hills Village.

As one can see, Englewood isn't letting water stand under its feet:

## ENGLEWOOD FORGES AHEAD

### Drainage Master Plans

(Continued from Page 4)

#### SPECIAL PROJECTS:

When developing drainage master plans, unforeseen problems may arise that are not included in the scope of services of the agreement, therefore, special recognition is required. This would be termed a special project. For example, in the development of a drainage master plan for Little Dry Creek, the structural integrity and costs to improve Englewood Dam to meet the State Engineer's requirements had to be determined. As of now, these Special Projects are handled by engaging a separate engineer and are financed by the District and the local entities involved.

### Tucker Talk

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Globeville residents who were hit hard during the May 1973 Platte River flooding have also been subjected to additional flooding due to localized storms and the lack of adequate drainage facilities. These events and others like them point out the need for the District and affected local entities to continue our evaluation of the drainage and flood control problems on the various drainageways tributary to the South Platte River located in the Denver Metropolitan Region.

The flooding potential on the South Platte River was significantly reduced on August 15th by the closure of the Chatfield Dam immediately upstream from Littleton. With appropriate ceremonies highlighted by the presence of Vice President Spiro T. Agnew, the \$85 million dam and reservoir project was declared 71 percent finished with completion scheduled for the summer of 1976. The project was activated following the 1965 flood which caused \$325 million in damage — one of 20 costly floods in the South Platte basin in the Denver metropolitan area since 1844.

Designed and built by the Omaha District of the U. S. Army Corps of Engineers, the Chatfield project features an earthfill dam 147 feet high and almost 2½ miles long. It will impound a lake of 235,000 acre feet which will be developed for a variety of recreational uses. It will be another year before the dam is completely closed.

Important as the Chatfield Dam project is — to be supplemented before long by the Mount Carbon dam and reservoir near Morrison — there will remain many potentially dangerous streams and gulches which will continue to pose flood threats for portions of the Denver Metropolitan Area. Chatfield is a major achievement toward needed flood control, but much remains to be done.

# THE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

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Richard McLean  
*City of Boulder*

Charles S. Robinson  
*Engineer*

L. SCOTT TUCKER  
*Executive Director*  
Silco Oil Building, 181 East 56th Avenue  
Denver, Colorado 80216  
Telephone: (303) 534-0105

## MEMBERS:

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FLOOD HAZARD NEWS  
Henry W. Hough, Editor

*“Dedicated to reducing the danger to property  
and to the health and safety of persons living in the urban area”*

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