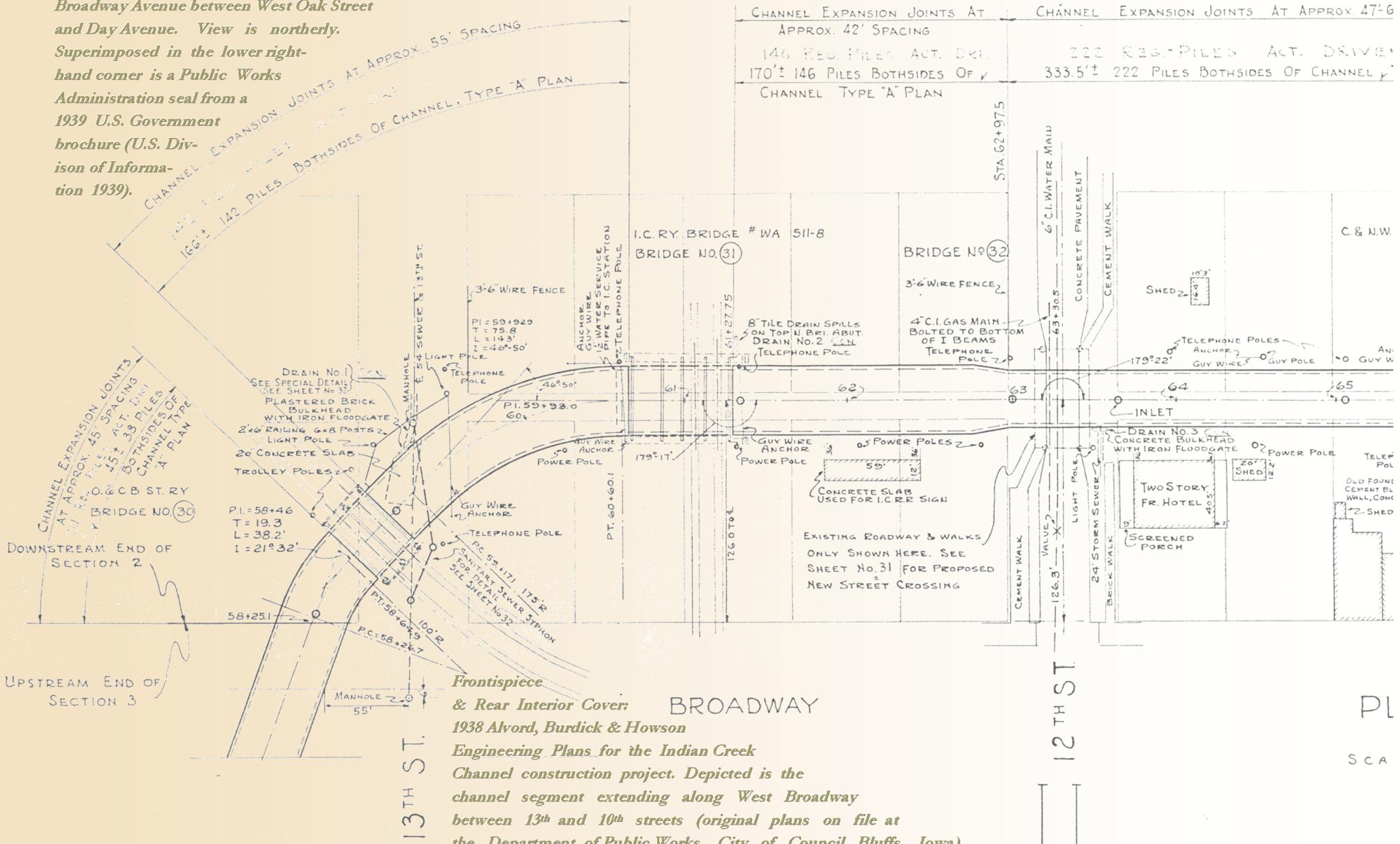


INDIAN CREEK CHANNEL

THE EVOLUTION & SIGNIFICANCE OF AN HISTORIC
PUBLIC WORKS ADMINISTRATION FLOOD CONTROL
FACILITY, COUNCIL BLUFFS, IOWA



Front & Rear Exterior Covers: Present-day stylized view of the Indian Creek Channel from North Broadway Avenue between West Oak Street and Day Avenue. View is northerly. Superimposed in the lower right-hand corner is a Public Works Administration seal from a 1939 U.S. Government brochure (U.S. Division of Information 1939).



Frontispiece & Rear Interior Cover: 1938 Alvord, Burdick & Howson Engineering Plans for the Indian Creek Channel construction project. Depicted is the channel segment extending along West Broadway between 13th and 10th streets (original plans on file at the Department of Public Works, City of Council Bluffs, Iowa).

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INDIAN CREEK CHANNEL

THE EVOLUTION & SIGNIFICANCE OF AN HISTORIC PUBLIC WORKS ADMINISTRATION FLOOD CONTROL FACILITY, COUNCIL BLUFFS, IOWA

AUSTIN A. BUHTA & HARRY F. THOMPSON

Council Bluffs, Iowa, 1936. Plagued for nearly a century by the perennial flooding of Indian Creek, the City begins construction on a massive channelization project designed to confine the creek to its banks. Funded largely through a grant from the recently established Public Works Administration (PWA), the Indian Creek Channel, upon its completion two years later, would become the largest PWA undertaking in the State of Iowa. Though it did not completely end flooding in Council Bluffs, construction of the Indian Creek Channel did substantially reduce both the number and severity of the city's subsequent floods. It also profoundly impacted the residential and commercial development of Council Bluffs, as well as the city's sanitary conditions. The effects of the Indian Creek channelization, both practical and historical, are still realized today. In 2009, plans for a City road and bridge construction project at the intersection of North Broadway Street and Kanesville Boulevard proposed to replace a 221-foot-long segment of the Indian Creek Channel with a concrete box culvert. In compliance with the National Historic Preservation Act, a cultural resources study was conducted at the proposed construction site, the findings of which concluded that the historic character of the Indian Creek Channel would be compromised by the impending construction. As a means of mitigating these damages, an agreement was reached among the City, the Iowa State Historic Preservation Office, and the Federal Highway Administration that resulted in detailed research and documentation of the historical significance of the Indian Creek Channel. The findings of that study are summarized in this publication.

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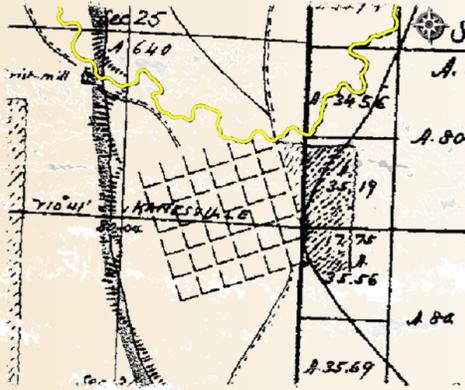
INDIAN CREEK: PAST & PRESENT

Indian Creek is a tributary of the Missouri River that heads in the Iowa Loess Hills approximately four miles north of Council Bluffs. Its watershed is relatively small, comprising just over 15 square miles – approximately half of which is within the present-day city limits of Council Bluffs.¹ The stream now flows largely in a southerly direction, passing through the heart of the city before discharging into the Missouri just west of Lake Manawa.

Within the city limits, Indian Creek flows through an open, concrete-lined culvert that begins at Council Lane and extends southward to Nicholas Street. From Nicholas Street, the creek flows south and west through a covered concrete channel to 13th Street, where it again emerges into an open concrete culvert at the intersection of 13th and West Broadway. At the West Broadway intersection, the creek passes south along 13th Street to 16th Avenue, where the channel transitions from concrete to an unlined earthen ditch. The creek remains confined to the ditch from this point until it reaches its confluence with the Missouri River at the southern edge of the city.



Segment of the present-day Indian Creek Channel as it approaches the intersection of North Broadway and Kaneshville Boulevard. View is southerly.



1852 General Land Office map identifying Kaneshville and the location of Dagger's Mill and highlighting the course of Indian Creek at the time (adapted from General Land Office 1852).

Indian Creek did not always follow such a linear course, however. In 1854, the creek was described as having “scarcely touched the western part of town.” It flowed along what is now Washington Avenue for about ½-mile before turning north on the then western edge of town. Here it ran, for a short distance, along the foot of

the bluffs, until it reached the swamp where Madison Dagger had built a grist mill several years prior.² It was only after a devastating flood in 1859 that the course of the creek began more closely to resemble that of the present-day (see below).

THE FLOOD EPIDEMIC

Because of its steep gradient of descent, narrowly-incised valley, and relatively small watershed, Indian Creek had, from the earliest days of record, demonstrated a propensity for flooding. The settlement of Miller's Hollow – later to be renamed Kaneshville, and subsequently Council Bluffs – was established in 1846 within the hollow of Indian Creek, and it was shortly thereafter that the creek came to be known derisively among the citizenry as *Lousie Creek*.³



Flood-lined streets of West Broadway near 10th Street following the storm of August 26, 1903 (courtesy of the Council Bluffs Public Library).

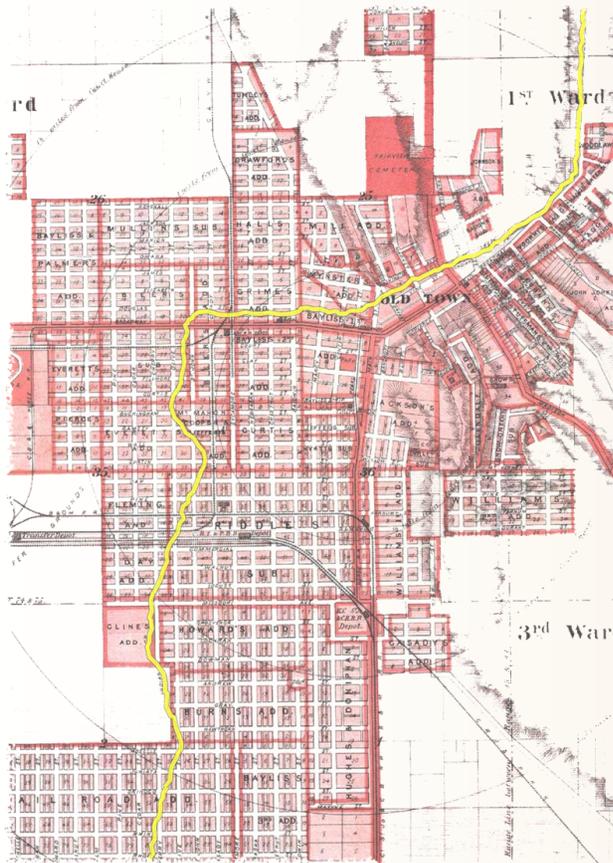
One of the earliest floods of record occurred in 1849 when it was reported that flood waters carried off “fences, bridges, and tents; driving families out of their houses and stock from their beds.”⁴ In 1859, the creek flooded again in an event described as “A most disastrous

flood...inundating the whole lower part of town.”⁵ Major floods were subsequently reported in 1865, 1883, 1898, 1901, 1903, 1906, 1909, 1914, 1917, 1919, 1920, 1923, 1925, 1926, and 1932.⁶ Less severe flooding episodes were also to be expected occasionally throughout the year.

Attempts to curtail the flooding of Indian Creek began early in the city's history; however, the results of

MAJOR FLOOD DATES OF RECORD ⁷	
1849	1909
	♦ JULY 5
1859	1917
	♦ JUNE 15
1883	1923
♦ JUNE 2	♦ SEPTEMBER 28
♦ JUNE 5	1932
♦ JUNE 6	♦ SEPTEMBER 25
1898	1935
♦ JUNE 9	♦ JUNE 24
♦ JULY 6	1942
1901	♦ JUNE 20
♦ SEPTEMBER 27	1947
1903	♦ AUGUST 24
♦ AUGUST 24	♦ JUNE 22
♦ AUGUST 26	1948
1906	♦ JULY 26
♦ JULY 26	♦ SEPTEMBER 1

these endeavors were often of little consequence. Following the 1859 flood, the course of the channel was altered from north of Frank Street to just west of the future Illinois Central Railroad tracks, at which point it was diverted southward.⁸ Although this sent the creek on a course relatively similar to its current route through the center of town, an examination of plat maps from the 1870s reveals that the channel was far from the confined, linear construct of today.



1875 Plat Map of Council Bluffs highlighting the course of Indian Creek at the time. Though the creek had already undergone one diversion, it was still allowed to meander (adapted from A. T. Andreas's *Illustrated Historical Atlas of the State of Iowa 1875*).

And the floods continued. Following flooding on June 2, 5, and 6, 1883, then City Engineer Benzette Williams proclaimed Indian Creek to be “the greatest drawback to the city’s prosperity.”⁹ The flood, having destroyed upwards of 75 houses and washed-away multiple bridges, was so devastating that it drew national attention, being reported in an article in the June 3rd edition of the *New York Times*.¹⁰

More floods plagued the city following the turn of the century. Heavy rains on the 24th and 26th of August, 1903, sent water over all of the bridges between 6th and 15th streets.¹¹ In 1909, an article from the July 5th edition of the *Nonpariel* reported the flooding of 75 city blocks west of 6th Street.¹² On September 28, 1923, thunderstorms produced record flood levels in the business district, damaging properties “as far east as Bryant Street.”¹³

Following the 1923 flood, efforts were directed toward further altering the creek channel. Construction work, which began in 1924 and was completed in 1925, resulted in the straightening of the channel west along 28th Avenue to the river.¹⁴ An array of additional techniques was employed in an attempt to contain the creek: the channel was dredged,¹⁵ retaining walls were erected,¹⁶ and one segment between Bryant and 6th Street was even enclosed in a concrete box culvert.¹⁷ Despite such efforts, however, the flooding continued. A storm in 1932 brought severe flood damage, and in 1935, the worst flood of record to date beset the city.¹⁸

The exact amount of damage and financial loss sustained by private parties involved in these catastrophes has never been calculated. However, figures indicate that the city



The thunderstorm of September 28, 1923 clogged the streets with mud and silt (left) and inundated numerous homes and businesses (below) along West Broadway (courtesy of the Council Bluffs Public Library).

alone paid a total of \$834,000 in flood damage reparation costs between 1883 and 1932 – an average annual cost of \$55,000. The true cost, including damage to private property, was estimated by certain city and railroad officials to have eclipsed several million dollars during this time.¹⁹

In addition to being a constant flood nuisance, Indian Creek had attained a certain degree of notoriety as a health hazard, an unofficial city dump, and a general eyesore. A 1910 survey documented that numerous areas along the creek, particularly within the business district, were being utilized for the disposal of all varieties of garbage.²⁰ The problem that was Indian Creek desperately needed to be resolved. Fortunately for Council Bluffs, a new federal program that was designed to assist in the resolution of just such a dilemma had recently been introduced under Franklin Delano Roosevelt’s New Deal reform. It was called the Public Works Administration, and it had arrived none too soon.



THE PUBLIC WORKS ADMINISTRATION

The Public Works Administration (PWA) was created on June 16, 1933, by the National Industrial Recovery Act. One of Franklin D. Roosevelt's famed New Deal programs, the PWA was an economic reform plan designed to combat the Great Depression by providing federal funding for the construction of public works facilities. It was the intention of the U.S. Government that the PWA would assist in revitalizing the American economy by concurrently providing new employment opportunities, improving public welfare, and stabilizing economic purchasing power.²¹

From July of 1933 through March of 1939, the PWA funded the construction of more than 34,000 public works projects with grants totaling in excess of six billion dollars.²² It was estimated that, during this time, the PWA provided funding for 70 percent of all educational buildings constructed; 65 percent of all sewage treatment plants; 65 percent of all courthouses, city halls, and other public buildings; 35 percent of all hospitals; and 10 percent of all roads, bridges, subways, channels, dams, and other structures built.²³

The PWA was administered by then U.S. Secretary of the Interior Harold LeClaire Ickes. Under the purview of Ickes, PWA resources funded the construction of some of the most ambitious and nationally significant engineering works of the 1930s. Among the more well-known projects are the Lincoln Tunnel and the Triborough Bridge in New York City; the Key West Highway in Florida; the Grand Coulee Dam in Washington; a port in Brownsville, Texas; a major sewer system in Chicago; and the Bonneville Power and Navigation Dam in Oregon.²⁴ The PWA was also responsible for funding the electrification of the Pennsylvania Railroad be-

tween New York City and Washington, D.C., the construction of aircraft carriers and airports, numerous sewer and flood control systems, and some 25,000 housing units throughout the nation.

A variety of notable construction projects were undertaken in Iowa with the assistance of PWA grants. Among these are the Davenport Bridge that spans the Mississippi River and links Iowa with Illinois; over 50 sewage disposal plants in 14 different cities along the Cedar, Des Moines, and Iowa rivers; theater buildings at the University of Iowa; lock and dam facilities along the Mississippi in Burlington and Guttenberg; and numerous municipal pools.²⁵ In Council Bluffs, PWA projects of note include the South Omaha Bridge that spans the Missouri and connects west Council Bluffs with Omaha's stockyards, Council Bluffs City Hall, and the Indian Creek Channel.²⁶

President Roosevelt was staunchly opposed to deficit spending, and although he was eventually convinced to include the PWA as part of his New Deal reform, spending never reached the level considered by proponents to be necessary for its ultimate success. Despite the immense investment of federal dollars in the PWA, eco-



Workman at the Mississippi River Dam No. 10 construction site, Guttenberg, Iowa, August 15, 1935. The project was funded in part by a grant administered through the PWA (courtesy of the Franklin D. Roosevelt Presidential Library and Museum. Photograph No. 27-0900a).

nomc and industrial activity failed to regain the level it had attained during the 1920s. The high rate of unemployment also persisted in spite of the millions of additional jobs generated by the program.²⁷

Practical shortcomings notwithstanding, the PWA did provide tens-of-thousands of quality, lasting public works facilities to a nation in desperate need of them. Moreover, this was accomplished during a time when alternative options for funding such endeavors were extremely limited.

On July 1, 1939, as a component of President Roosevelt's reorganization plan, the PWA was subsumed under the Federal Works Agency.²⁸ Less than two years later, in June of 1941, the PWA was officially ended as industry shifted its focus toward the manufacturing of war-related products.²⁹

PUBLIC WORKS ADMINISTRATION PROJECTS OF NOTE IN IOWA

FLOOD CONTROL

- ◆ INDIAN CREEK CHANNEL

TRANSPORTATION

- ◆ DAVENPORT BRIDGE
- ◆ SOUTH OMAHA BRIDGE

SANITATION/SEWAGE

- ◆ 50+ SEWAGE DISPOSAL PLANTS IN 14 CITIES ALONG CEDAR, DES MOINES, & IOWA RIVERS

BUILDINGS

- ◆ COUNCIL BLUFFS CITY HALL
- ◆ UNIVERSITY OF IOWA THEATERS

RIVER NAVIGATION

- ◆ LOCK & DAM FACILITIES ALONG MISSISSIPPI AT BURLINGTON & GUTTENBERG

MISCELLANEOUS

- ◆ MUNICIPAL POOLS IN SEVERAL CITIES

**A MONUMENTAL UNDERTAKING –
A BRIEF RESPITE**

On August 8, 1935, in the aftermath of the most recent flood, a committee previously formed for the improvement of Indian Creek petitioned the Council Bluffs city council to issue \$908,743 in municipal bonds to match \$743,000 in PWA grant funds for improvements to the creek.³⁰ Official approval for the federally appropriated funds had come earlier that week, following more than two years of lobbying, stalls, and bill revisions in the U.S. House and Senate. Bonds were issued shortly thereafter, and on March 2, 1936, the Indian Creek Flood Control Project officially commenced with a groundbreaking ceremony held at the corner of 13th Street and Broadway. At the ceremony, Mayor Hugh Finerty deferred the honor of digging the first shovelful of earth to City Councilman-at-large George Steinberg, one of the strongest supporters of the Indian Creek project.³¹

The Indian Creek project was designed by the Chicago-based engineering firm of Alvord, Burdick & Howson, which was awarded the contract in April of 1935.³² Overseen by then City Engineer Jack Boyne, a total of nine construction contracts were awarded for work on the project. Among those involved in the undertaking were local area firms John



Ground-breaking ceremony, Indian Creek Flood Control Project, March 2, 1936 (courtesy of the Council Bluffs Public Library).

Kearns Construction and Union Construction.³³

The project resulted in the construction of approximately 7.2 miles of channel, including 15,800 feet of earthen ditch, 14,599 feet of open, concrete-lined channel, and 7,368 feet of closed concrete channel. Also included as part of the project were the erection of 28,200 feet of safety fencing, the construction of 26 city bridges, and the realignment of seven railroad bridges. It was estimated that some 46,000 tons of reinforcing steel and 71,287 barrels of cement were used in the construction of the channel.³⁴

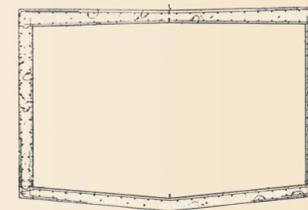
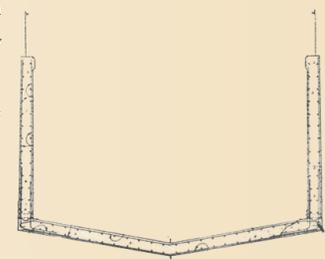
The channel dimensions varied within the city limits in accordance with a multitude of obstacles and other factors. Typical channel segments in the northern part of the city measured 22 feet in width by 15 feet in depth; covered sections measured just over 14 feet in depth. Further south, segments reached widths of between 30 and 37 feet, with some areas near the earthen ditch transition and beneath bridges exceeding 40 feet in width. Properly maintained, the facility was designed to withstand a provisional flood of 6,000 cubic feet per second entering the Missouri River at flood stage. Data indicated that the largest flood of past record had reached approximately 3,500 cubic feet per second.³⁵

On September 12, 1938, approximately two-and-a-half years after its commencement, the Indian Creek Flood Control Project was completed. Estimates

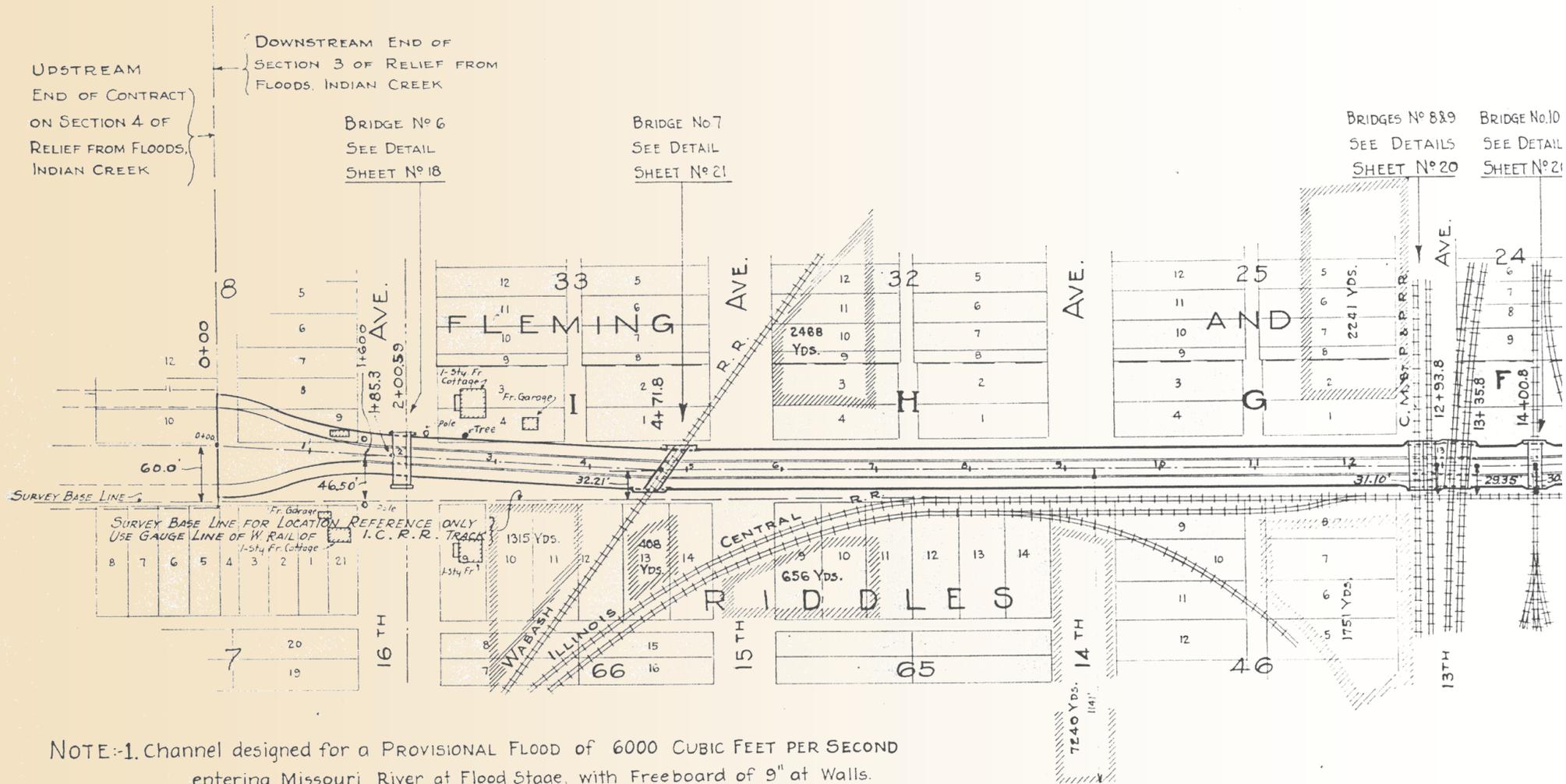


Onlookers observe early-stage construction of the Indian Creek channel improvements near the Chicago & North Western Railroad bridge at 1st Avenue (courtesy of the Pottawattamie County Historical Society [no date]).

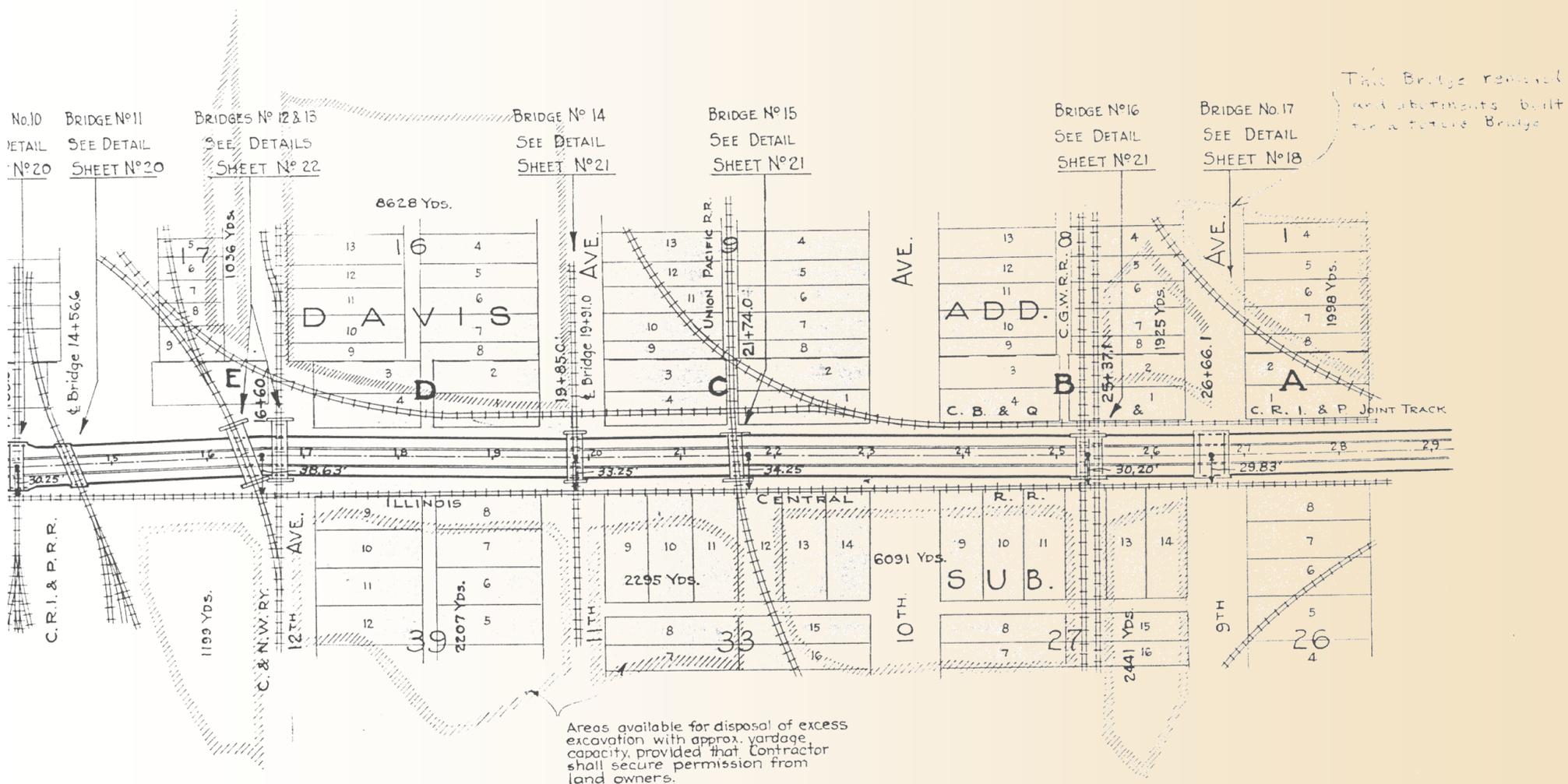
provided to the PWA indicated that the project required 525,000 person-hours of labor to complete, and that several thousand additional person-hours were required to manufacture the materials utilized.³⁶ At a total cost of \$1,700,000, the project simultaneously became the largest improvement project in Council Bluffs history and the largest PWA-funded project in the state of Iowa.³⁷



Cross-section schematics of typical 22-foot open (above) and covered (left) concrete channel segments (from Alvord, Burdick & Howson 1938).



- NOTE:-1. Channel designed for a PROVISIONAL FLOOD of 6000 CUBIC FEET PER SECOND entering Missouri River at Flood Stage, with Freeboard of 9" at Walls.
2. Greatest past flood about 3500 CUBIC FEET PER SECOND with Freeboard at walls about 4 ft. 4 in.
3. High Water marks on drawings refer to PROVISIONAL FLOOD.



1938 Alvord, Burdick & Howson Engineering Plans for the Indian Creek Channel construction project. Depicted is the channel segment extending adjacent to 14th Street between 9th and 16th avenues (original plans on file at the Department of Public Works, City of Council Bluffs, Iowa).

PLAN
 SCALE 1"=100'

**MORE WAITING, MORE FLOODING,
DELAYED RESOLUTIONS...**

By January of 1940, not two years subsequent to the completion of the Indian Creek Flood Control Project, additional alterations to the channel were necessary. A 1.5-mile-long extension to the southern terminus of the ditch was needed to provide an unobstructed outlet to the Missouri River. The project, estimated at a cost of \$18,000, became necessary when the U.S. Army Corps of Engineers shifted the Missouri River channel, leaving the originally constructed Indian Creek outlet to empty into a slough of willow-riddled sandbars instead of the river channel itself. All expenses incurred as a result of this construction were to be assumed by the U.S. Government.³⁸

However, funds were not appropriated due to the onset of U.S. involvement in World War II, and the use of a makeshift channel was required. Reports indicated that by 1942, this channel had, in the absence of a properly functioning outlet, filled with silt and left the creek as flood-prone as it had been prior to the channelization project.³⁹



A motorist wades through floodwaters on West Broadway near the Illinois Central and North Western Railroad tracks during the flood of June 22, 1947 (courtesy of the Council Bluffs Daily Nonpareil).

Predictably, on the 20th of June that year, a major storm sent the silt-clogged creek over its banks and into the city once again. Deemed one of the most devastating floods in the city's history, the torrential waters passing through Indian Creek Channel produced such a degree of pressure that the deck of the 7th Street Bridge was elevated several feet as a result.⁴⁰ It was also reported that police had to use a boat to rescue some 25 families trapped on the south side of town during the storm.⁴¹

Nearly five years to the day later, on June 22, 1947, a storm brought over three inches of rain to the city and the silt-clogged creek flooded once more. Chest-deep water was reported in the lower parts of town and this time, water pressure actually raised the concrete cover over a portion of the enclosed creek channel near 8th Street.⁴² Approximately 148 city blocks were reportedly flooded as a result of the storm.⁴³

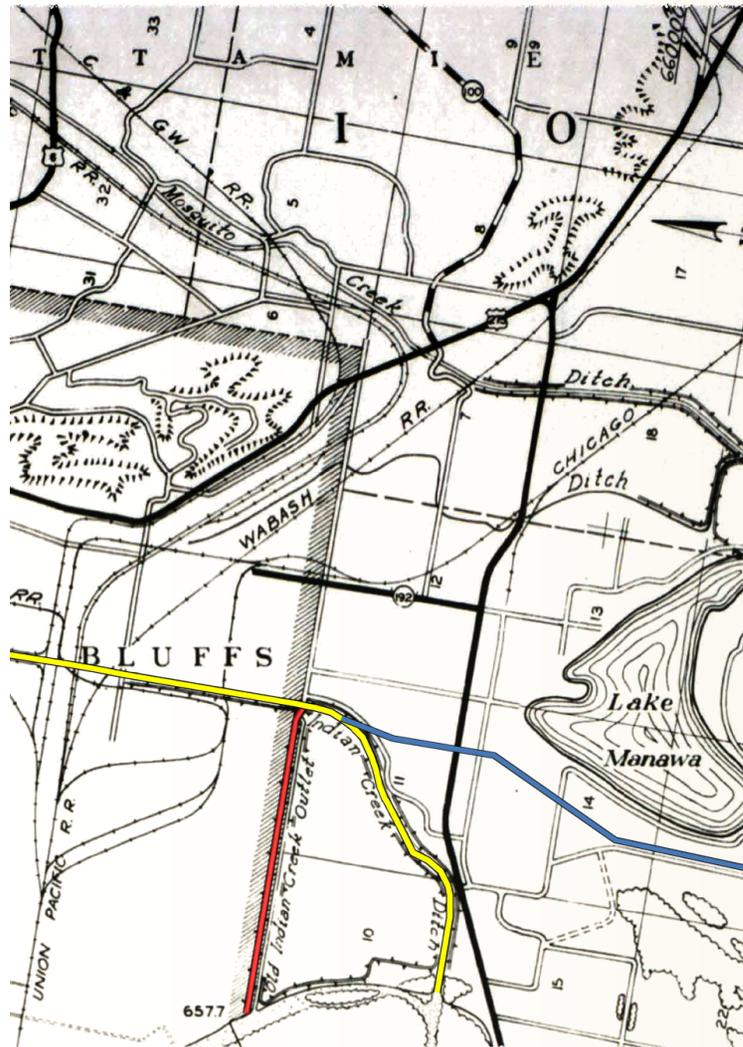
Since its completion, the creek channel had saved the city from several less severe flooding episodes; however, the lack of a proper outlet into the Missouri River was causing silt deposits to fill the channel rapidly, thereby reducing the effectiveness of the facility and increasing the flood danger to the city. Fortunately, the end of the war afforded the U.S. Army Corps of Engineers an opportunity to refocus attention toward the Council Bluffs flood dilemma. Less than a week after the 1947 flood, then mayor Phil Minner lauded a proposed Corps-developed flood-control strategy to extend the Missouri River levee around the southern reaches of the city. Included as an essential component of this plan was the construction of a proper outlet for Indian Creek, one that would send the channel southward from 29th Avenue and 14th Street to the river just west of Lake Manawa.⁴⁴

Work on the extension of the creek outlet and levee system commenced in the summer of 1949 and was completed by the following year, a decade after the project was authorized by Congress.⁴⁵ Construction of the



1940 U.S. Army Corps of Engineers Missouri River map of the Council Bluffs area. Highlighted in yellow is the route of the Indian Creek Channel following completion of PWA construction. The segment highlighted in purple denotes the covered portion of

Indian Creek portion of the project was completed by Ace Construction, an Omaha-based firm. The cost of the entire project was estimated to have exceeded \$1,000,000.⁴⁶



the channel, while the segment highlighted in red identifies the previous creek outlet straightened during 1925 improvements. The blue-colored segment represents the present-day outlet of the channel (adapted from U.S. Army Corps of Engineers 1940).

By the time the levee and creek outlet expansion project was concluding, additional discussions were underway that were attempting to address the flood diversion dilemma as it related to the larger watershed of Indian Creek north of Council Bluffs. Studies eventually determined that the introduction of multiple dams, lakes, spillways, and cooperative conservation practices north of the city would greatly reduce the flood hazard by affording increased water flow management capabilities.⁴⁷ However, formal plans for structural work in the watershed north of town were not completed until 1961. The plans included the construction of 15 grade-stabilization structures and conservation practices. These practices were not completed in total until 1976.⁴⁸

MEASURED SUCCESS & A PROMISING FUTURE

Indian Creek, once a perennial nuisance and threat to Council Bluffs and its residents, has not strayed from the confines of its banks in nearly 60 years. Recently, rehabilitation work was conducted at one of the dam structures located north of the city in the Indian Creek watershed. This work strengthened the structure and expanded its retaining capacity, thereby providing an added degree of protection for several newer residential and commercial office buildings located just downstream. Estimates reported in 2005 indicated that the presence of this single dam structure resulted in an annual savings to the city of \$93,200 in sediment and erosion damages, bridge repair costs, and other indirect benefits.⁴⁹

In total, the flood control work performed on Indian Creek – particularly since the 1936 PWA undertaking – has enabled the continued operation, preservation, and development of countless businesses, residential properties, and public facilities without fear of catastrophic flooding. This is especially significant with respect to private residences, as well as a number of public facilities



View of Indian Creek facing North 2nd Street in 1900. View is easterly (courtesy of the Council Bluffs Public Library).

located immediately adjacent to the creek channel, such as Fire Station No. 6 and Mercy Hospital at the intersection of Kanesville Boulevard and North Broadway. The unimpeded operation of these facilities is of paramount importance to both the City of Council Bluffs and its residents.



Present-day view of Indian Creek channel facing North 2nd Street. Creek now runs below the street here. View is easterly (courtesy of John R. Bozell).

Historically, the Indian Creek Channel derives significance from its pivotal role in the development of Council Bluffs. It also serves as an exemplary model of an innovative early twentieth-century flood control facility, and is a principal example of engineering and construction associated with the PWA. In 2005, the Indian Creek Channel, together with eight associated railroad bridges, was determined to be eligible for inclusion in the National Register of Historic Places.⁵⁰

The value of the Indian Creek flood control facility is not limited simply to historical substance, nor is it constrained to the more practical realm of precluding substantial property damages and personal injury. Its significance is also realized through the role it plays in the present and future development of Council Bluffs.

The Council Bluffs Parks & Recreation Department has constructed a recreational pedestrian and bicycle trail along a portion of the Indian Creek Channel. The Indian Creek Trail is currently a 3.5-mile-long course that runs from near the southwestern edge of Lake Manawa north



A new housing development adjacent to the Indian Creek Channel on 14th Avenue. These homes are also afforded protection from flooding because of the channel improvements. View is northeasterly (courtesy of John R. Bozell).

along the channel before terminating within the city limits at South 10th Street and 16th Avenue near Sunset Park.⁵¹

Plans are in place to extend the Indian Creek Trail further northward and through the downtown business district in the future. This route would take visitors past more of the concrete-lined channel segments, as well as along portions of the covered concrete channel beneath Creektop Street. The city's Recreational Trails Master Plan also includes the future southward extension of the Indian Creek Trail to its outlet at the Missouri River.⁵² Expansion of this trail will afford the visiting public the practical and recreational benefits of such a facility while simultaneously exposing them to a vital structural and historical component of the city of Council Bluffs.

The significance of the Indian Creek Channel transcends that of a simple flood control facility. Its importance cannot aptly be quantified in economic figures, for such things as security and peace-of-

mind must then be entered into the equation. It affects the lives of thousands of Council Bluffs citizens daily by protecting their businesses, hospitals, fire stations, homes, and loved-ones from potential irreparable loss. The role of the Indian Creek Channel is an evolving one. It is a route of transportation and a place of recreation. It is a representation of the history of engineering, the history of Council Bluffs, and the history of the Public Works Administration. It is a testament to the rebuilding of a nation, and it is as integral to the ongoing and future development of Council Bluffs as it has been to the city's history.



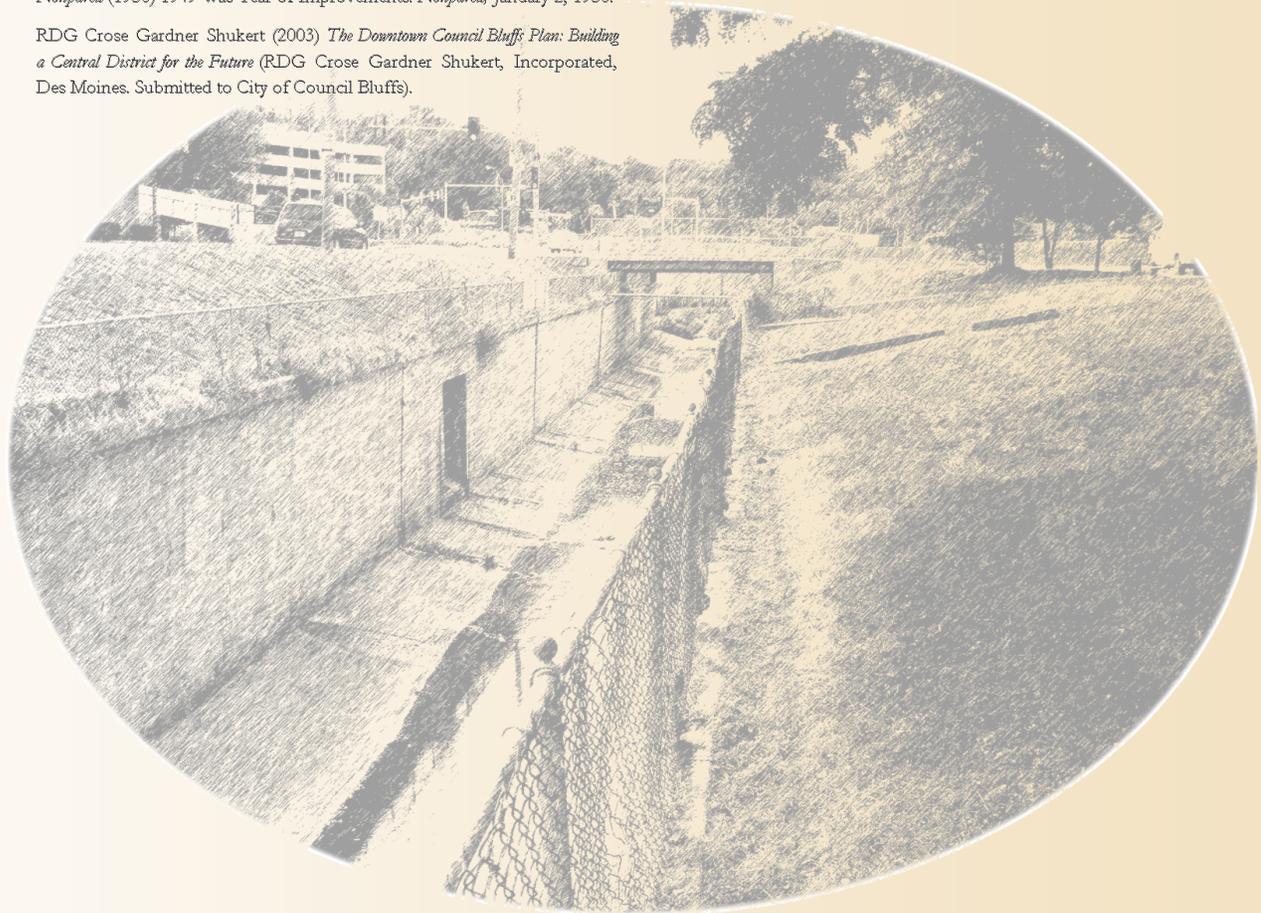
Southwesterly view of Fire Station No. 6 and Mercy Hospital adjacent to the Indian Creek Channel. These important public facilities would be in constant danger of flooding were it not for the creek channel improvements.



Southerly view of the Indian Creek Trail near South 10th Street and 16th Avenue. The Council Bluffs Recreation Trails Master Plan calls for future northward and southward expansion of the trail (courtesy of John R. Bozell).

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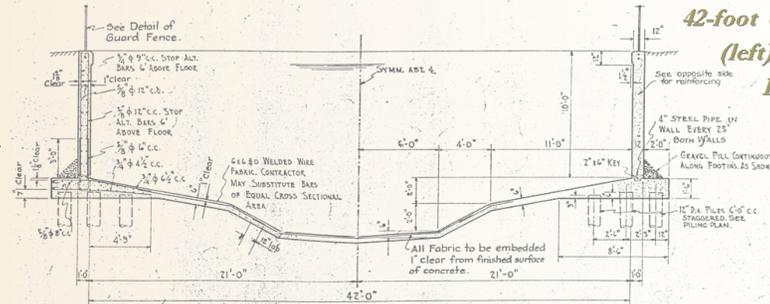
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END NOTES

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| 5 Sanford 1933 (November 24). | 31 <i>Nonpareil</i> 1936 (March 3). |
| 6 Rogers 2005:29. | 32 ibid. |
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| 8 Sanford 1933 (November 24). | 34 <i>Nonpareil</i> 1938 (September 11). |
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| 10 <i>New York Times</i> 1883 (June 3). | 36 <i>Nonpareil</i> 1938 (September 11). |
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| 13 <i>Nonpareil</i> 1923 (September 28). | 39 <i>Mason City Globe-Gazette</i> 1942 (August 1). |
| 14 Sanford 1933 (November 24). | 40 <i>Nonpareil</i> 1942 (June 20). |
| 15 Field and Reed 1907:67. | 41 <i>Muscatine Journal and News</i> 1942 (June 20). |
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| 17 Warner 2005:4. | 43 <i>Nonpareil</i> 1947 (June 22). |
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| 26 Larsen et al. 2007:250. | 52 RDG Crose Gardner Shukert 2003:24. |

Cross-section schematics of typical 42-foot open concrete channel (left) and the 14th Street Bridge (below left) (from Alvord, Burdick & Howson 1938).



ACKNOWLEDGEMENTS

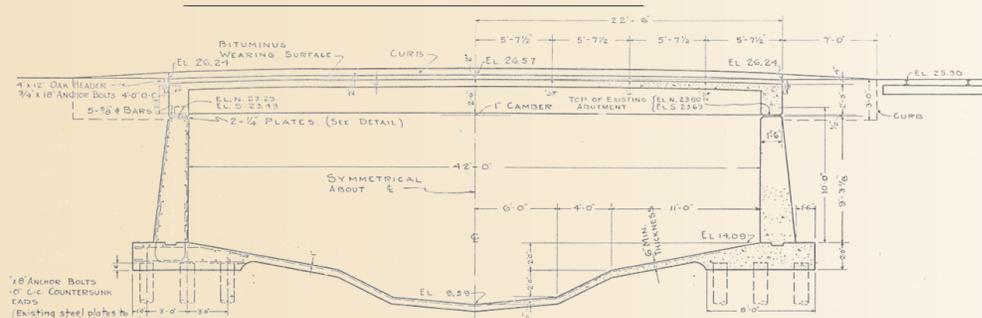
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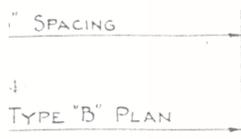
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SUGGESTED FURTHER READING

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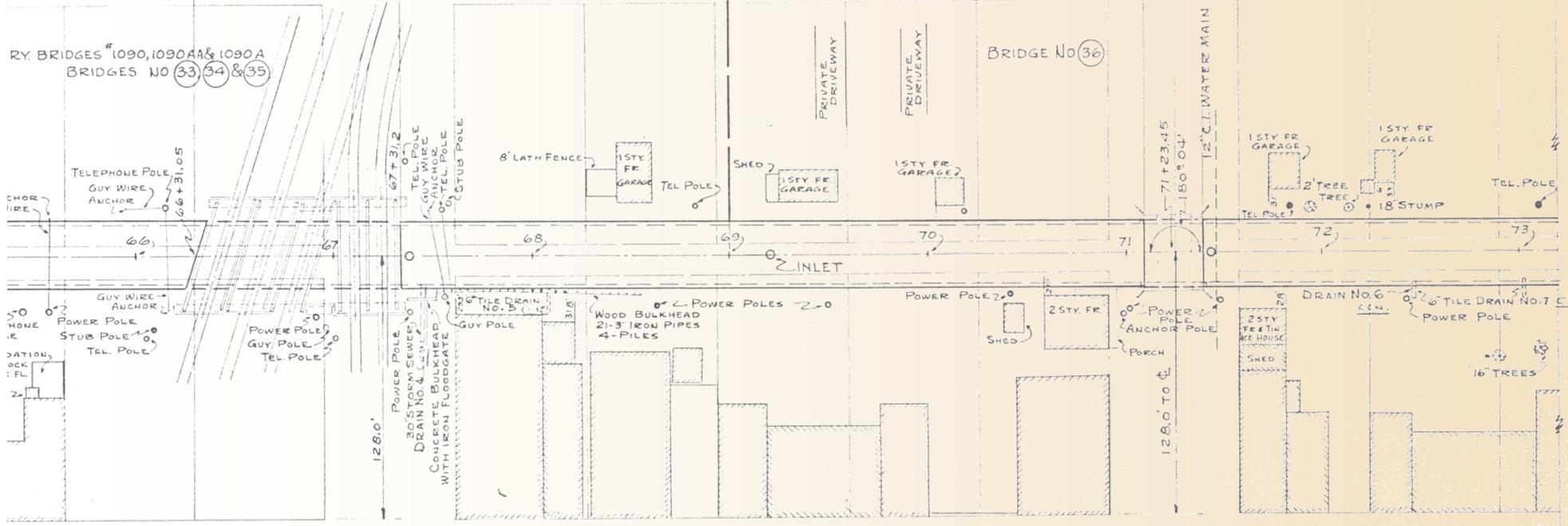
CHANNEL EXPANSION JOINTS AT APPROX. 42' SPACING
 159 REG. PILES
 169 ± 114 PILES BOTH SIDES OF CHANNEL TYPE "B" PLAN

CHANNEL EXPANSION JOINTS AT APPROX. 52' SPACING
 ACT. DRIVEN
 208.5 ± 132 PILES BOTH SIDES OF CHANNEL TYPE "B" PLAN

CHANNEL EXPANSION JOINTS TO WEST SIDE OF 9TH ST BRIDGE AT APPROX. 52' SPACING
 242 REG. PILES ACT. DRIVEN
 364.0 ± TO WEST SIDE OF 9TH ST BRIDGE
 244 PILES BOTH SIDES OF CHANNEL TYPE "B" PLAN

NOTE: EXPANSION JOINT AT STA. 69+00 INCLUDED IN MIDDLE SECTION

RY. BRIDGES #1090, 1090AA & 1090A
 BRIDGES NO. 33, 34 & 35



PLAN
 SCALE 1" = 50'

11 TH. ST.

10 TH. ST.

C.I. INLET FRAME & GRATING TO BE INSTALLED WHERE INDICATED, WITH TOP 1/2" BELOW GRADE OF CONCRETE SURFACE. SEE TRANSITION SECTION SHEET NO. 29

