Chapman Lakes Watershed
Highland Drain Design-Build Project
Kosciusko County, Indiana

May 2008

Prepared for:
The Chapman Lakes Foundation
PO Box 776
Warsaw, Indiana 46581-0776

and the

Lake and River Enhancement Program
Indiana Department of Natural Resources – Div. of Fish and Wildlife
1353 Governors Drive
Columbia City, Indiana 46725

Prepared by:
JFNew
708 Roosevelt Road
Walkerton, Indiana 46574
(574) 586-3400

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CHAPMAN LAKES WATERSHED
HIGHLAND PARK DRAIN DESIGN-BUILD PROJECT
KOSCIUSKO COUNTY, INDIANA

1.0 DESCRIPTION OF THE PROJECT AREA

1.1 Location

The Chapman Lakes watershed encompasses 4,808 acres (1,945 ha) in central Kosciusko County, Indiana (Figure 1). The relatively small Chapman Lakes watershed is part of the Tippecanoe River Basin, which conducts water to the Wabash River, a tributary of the Ohio River. Four main drainages transport runoff water from the watershed to the Chapman Lakes (Figure 2). These drainages include: Crooked Creek, Arrowhead Drain, Highland Park Drain, and Lozier Drain. This project focuses specifically on the Highland Park Drain subwatershed. Highland Park Drain carries runoff from approximately 96 acres (39 ha) to Little Chapman Lake.

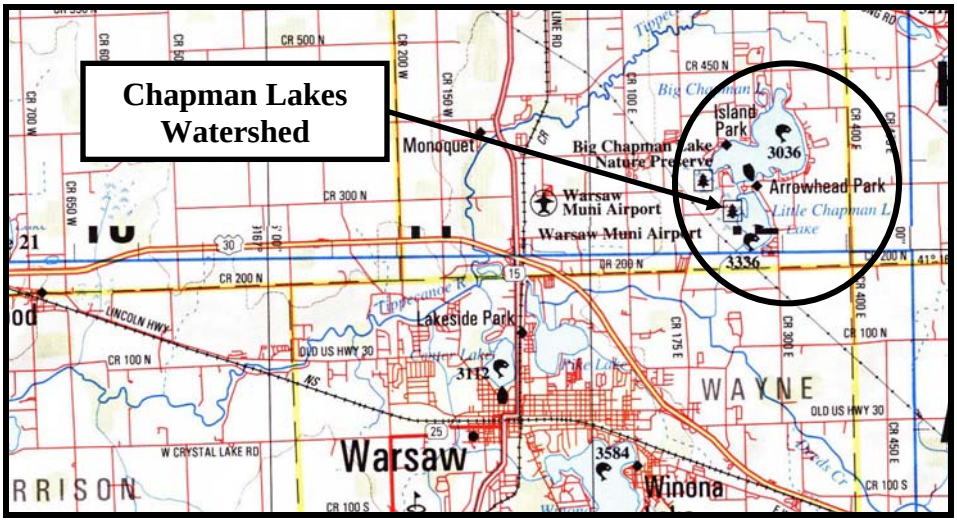


Figure 1. General location.

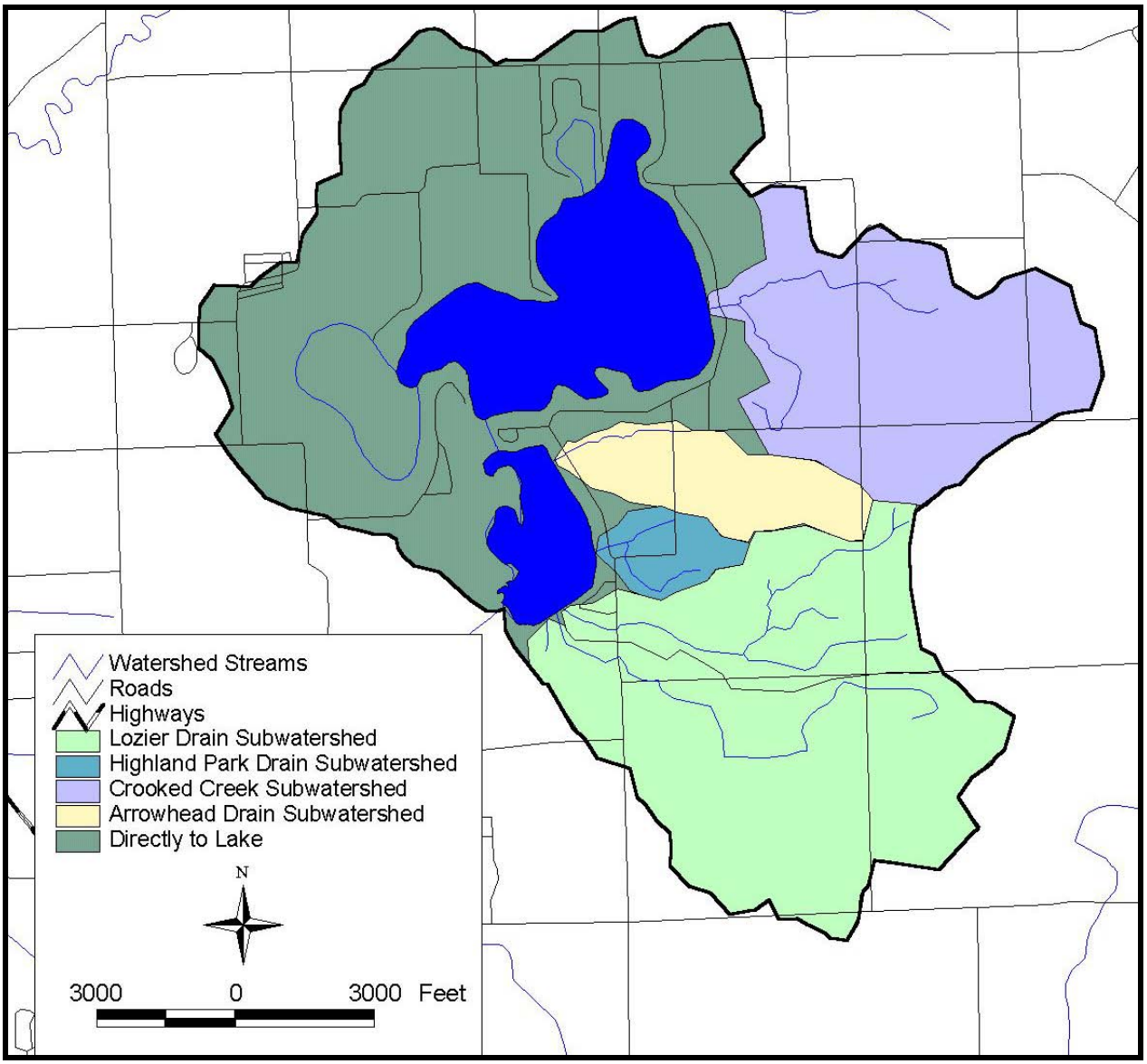


Figure 2. Chapman Lakes subwatersheds.

2.0 PROJECT PURPOSE

2.1 Site Description and Alternatives

The Highland Park Drain project site is located along the eastern side of Little Chapman Lake northeast of the intersection of County Road 250 North and Chapman Lake Drive (Figure 3). The Highland Park Drain subwatershed drains approximately 96 acres (39 ha) from its headwaters to its mouth. The drain originates as two branches including a grassed waterway to the north and an open drain through an agricultural field to the east. Both branches converge on a rural residential lot located 100 feet northeast of the intersection of 250 N. and Chapman Lake Drive (Figure 3). The drain is not a legal drain, which means that the Kosciusko County Surveyor's office does not collect ditch assessment fees or maintain the ditch itself in any fashion. JFNew (2006) completed a feasibility study on the implementation of rock check dams to control erosion in this stream reach.

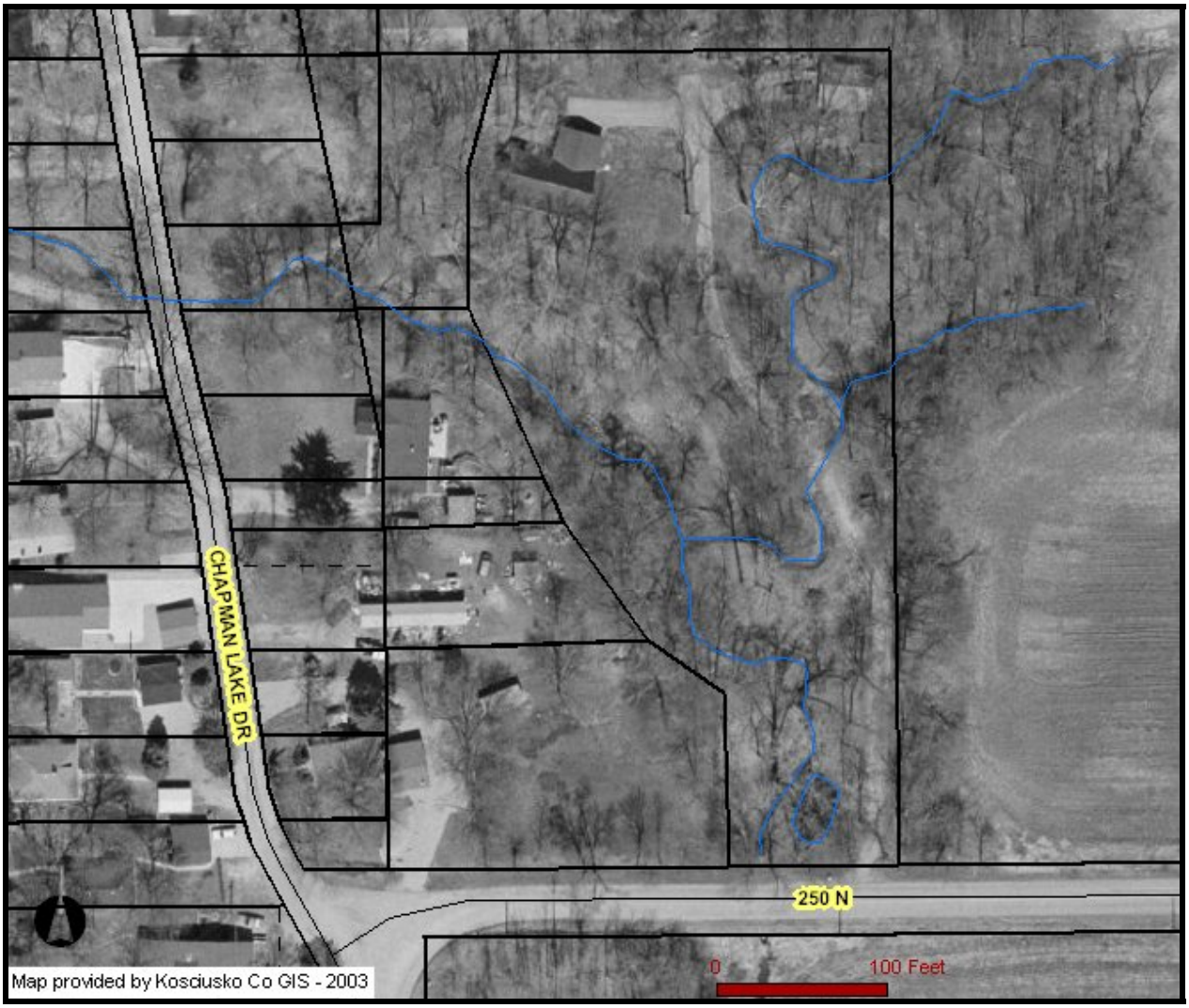


Figure 3. Aerial photograph of the Highland Park Drain project site.

The reach addressed with this design-build project includes approximately 1,000 lineal feet of intermittent stream channels. The stream is generally dry; however, during periods of heavy precipitation, water moves through the meandering channels at a rapid pace, creating a flashy system. Flashy streams, such as Highland Park Drain, are often subjected to greater peak flows as a result of the volume and velocity of surface runoff (Fergus and Deak, 1994). Rapidly fluctuating water levels and high flow volumes increase the erosive force of the water resulting in streambank and bed erosion and channel head-cutting. As water erodes material at the toe of the slope, the streambanks become unstable. This results in the sloughing of bank material. The material is then carried downstream and deposited in areas of lower velocity. In this case, Little Chapman Lake receives all the sediment eroded from this drainage.

One main channel from the south and a tributary channel from the east carry storm water through the property. The main channel flows roughly north then west towards Little Chapman Lake. A small impoundment historically existed on the main stream just downstream of the tributary's confluence. This impoundment was created by a small earthen dam which had been constructed across the stream channel. At some point, the earthen dam was breached near its center creating another source of sediment to be carried away by the erosive force of the water. The dam is no longer functional. The intermittent tributary stream enters the main channel immediately upstream of the former earthen dam. The stream receives water from two smaller channels which combine approximately 200 feet to the east of the small stream's confluence with the main channel. The larger of the original two channels receives water from a 6-inch drainage tile that exits the grassed waterway in the agricultural field to the east, while the smaller of the two channels captures flow from an 8-inch tile draining the agricultural field to the east. Ultimately all of the channels combine to flow into a culvert which carries water beneath Chapman Lake Drive and into Little Chapman Lake. Due to the meandering nature of the stream, the channels exhibit varying degrees of head-cutting and streambank erosion along their length. (See Appendix A for pre-construction photographs of the site.)

3.0 PROJECT DESIGN

3.1 Design Concepts

Channel stabilization of Highland Park Drain consisted of the installation of a series of rock check dams to slow down the flow of water and increase access of the stream to its floodplain. Check dams are designed to effectively raise the bed elevation of the stream channel to a level where the average annual high flows fill the channel banks. Greater flows flood outside of the channel expending the water's energy in the floodplain rather than in the stream itself, thereby reducing the water's erosive action within the channel. Fine sediment and sediment-attached nutrients are deposited within the floodplain during flood events. Over a period of time, debris and sediment in the channel are deposited in the slack water areas between check dams. The sediment deposition will permanently raise the stream bed elevation to the level of the constructed check dam. Each check dam eventually backs water and sediment up to the base elevation of the next check dam or existing grade control upstream (Figure 4).

The downstream sides of the check dam eventually become stream riffles located between pools created by the check dams. The pools encourage sediment deposition and the riffles heights control how often the stream floods out of its banks and disperses energy.

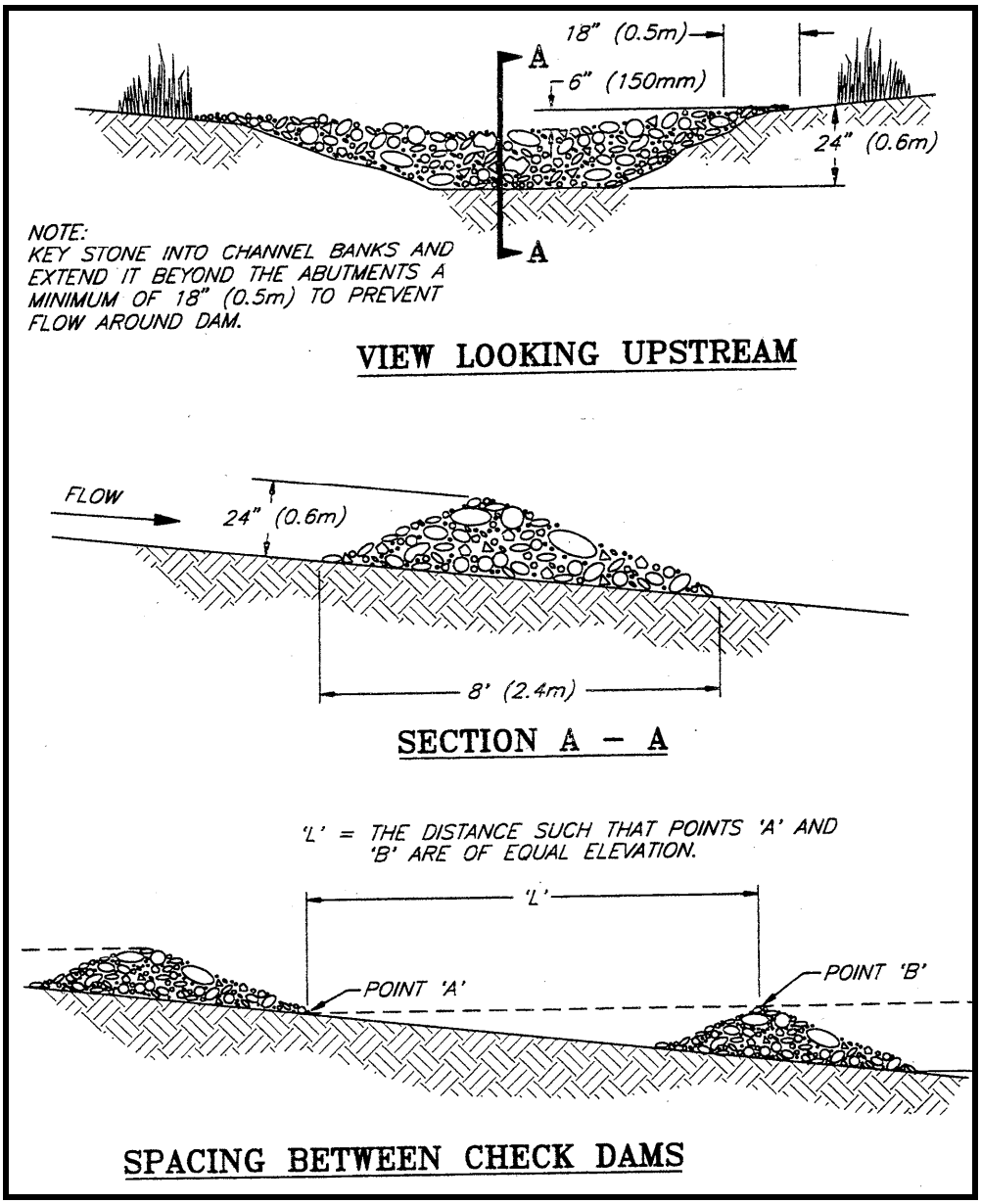


Figure 4. Typical cross section and profile view of a rock check dam.

3.2 Design Specifics

The draft design plans were completed in the spring of 2007 and approved by the landowner for construction. The draft plans included nine check dams ranging from at grade to three feet in height; bank protection on two outside bends; and additional culverts placed under the driveway (appendix A). The check dams were designed as grade controls to prevent further incision and begin the process of raising the bed

elevation. Initially, all structures were constructed using 3-5 inch diameter field stone. After six months many of the structures had been washed out. The structures were then rebuilt using 6-12 inch diameter field stone. While the larger field stone is unlikely to wash out, it will take longer to perform its function of building the base elevation of the stream. Water continues to flow through the rock structures until all voids are filled by debris in the stream. The smaller rock allowed for an immediate raise in the bed elevation.

The most upstream grade control at the culvert under 250 N. Road acts as a splash pad to prevent stream bed scour as water from upstream tiles and surface runoff is concentrated at the 36" inch diameter culvert. The check dam about 200 feet downstream is approximately 18 inches in height from the original bed leaving a one foot deep thalweg with a maximum stream width at bank full of about 8 feet. The next check dam downstream is just upstream (south) of the junction with the east branch. That check dam was constructed about two feet above the existing bed elevation leaving the same cross sectional area above the thalweg or center line of the stream.

The next check dam is about 50 feet downstream but includes water from both stream branches. The channel was severely incised at this point and therefore the grade control was constructed approximately three feet above the existing grade leaving a thalweg of 18 inches in depth with a top of bank width of about 12 feet. Downstream of this culvert and just south of the old dam another check dam was constructed to the same height above grade and capacity as the one upstream. Downstream of this final check dam the steep walls of the failed dam were protected at the toe of slope to prevent undercutting and continued erosion. Coconut fiber logs (also known as Coir fiber or biologs) were placed parallel to each bank for a distance of 30 feet and planted with Pennsylvania sedge (*Carex pennsylvanica*).

Beginning at the junction of the east fork a check dam was constructed about 40 feet upstream. This check dam was constructed to a height of about 2.5 feet leaving a thalweg of 18 inches and a top of bank width of eight feet. About 40 feet upstream of this check dam was an existing vertical headcut of about 2.5 feet. The water from the downstream check dam will back up to the base of the existing headcut. Therefore, the head cut was armored with field stone. Upstream of the head cut the existing channel had a 12 to 18 inch deep thalweg and eight foot top of bank width at bank full. The outside bank was vertical and eroding. Extra stone available was used to construct a rock toe at the approximate bankfull level to stabilize this outside bend. The stream paralleled the driveway for about 30 feet and this embankment was raked and seeded with Canada wild rye (*Elymus canadensis*) and seed oats. The seeded banks were then protected with a wood fiber erosion control blanket.

The stream then crossed under a gravel driveway. The existing culvert was 18 inches in diameter. It was inadequate to carry flood flows and the previous site owner had said that he was constantly fixing and adding gravel to his driveway. Engineering calculations on the watershed runoff determined that adding two 16-inch culverts would be adequate to handle most storm events. A 15 and an 18 inch diameter corrugated

metal culvert (CMP) were used initially added to the existing 18-inch because 16-inch CMP's were unavailable. After six months it was apparent that the three culverts (two 18 inch and one 15 inch) were still undersized as several precipitation events caused water to run over the road. The 15-inch CMP was replaced with a 24-inch oval CMP during April 2008 and set a lower elevation and in the center of the two 18-inch culverts. The cross sectional area of the combined culverts is now 6.67 square feet.

The east fork was stable upstream of the driveway culverts for approximately 100 feet until a 180 degree turn. The outside bend on this corner was a three foot high vertical eroding bank. The embankment was armored at the toe of slope with stone. The eroding banks above the bankfull level were protected with coconut fiber logs held to the bank with wooden stakes. The coconut logs were planted with Pennsylvania sedge.

Approximately 70 feet upstream from the 180 degree corner an existing former culvert crossing was acting as a temporary grade control. The temporary structure was left in place and a new check dam was constructed immediately downstream of the structure backing water and sediment up and over the old structure and raising the stream bed elevation (about 18 inches in height and six foot wide at the top of bank). This check dam and the remaining two check dams upstream of this point were filled with sediment to the proposed final grade within six months of the initial construction work.

The next check dam up stream was at the east property boundary. The final check dam was constructed about 60 feet east of the property line and about 60 feet downstream of a six inch tile outlet from the grass waterway. These check dams were constructed approximately one foot in height with a six to eight foot top of bank width and a one foot thalweg depth.

4.0 PROJECT LOGISTICS

4.1 Easement and Land Availability Determination

The majority of the Highland Park Drain project site was located on the former Slater property. Mr. Slater agreed to the plan of installing a series of check dams to control the erosion occurring within the intermittent streams located on his property. He requested that a larger culvert be installed under his driveway to accommodate flooding. Mr. Slater sold the property during the time of project implementation. The new owner, Janet Chidister, verbally agreed to allow us to complete the project. Two of the structures were constructed on property belonging to William McDaniel. Mr. McDaniel provided verbal permission to access his property. The project plans originally included a 300 foot long grass waterway extending south from 250 North Road along the border of an agricultural field and wood line. There are five owners of this parcel. Three of the five gave permission for the project; however, a controlling member refused.

4.2 Permit Requirements

No permits were required from the Indiana Department of Natural Resources for this project because the project site had a drainage area of less than one square mile at its downstream end. A permit was also not required from the Kosciusko County Drainage

Board since Highland Park Drain is not a regulated drain. A Regional General Permit notification was provided to the U.S. Army Corps of Engineers (Corps) and the Indiana Department of Environmental Management (IDEM) for fill placed below the Ordinary High Water Mark of the stream within a “waters of the United States” (Appendix B).

4.3 Construction Timing

Construction began in September of 2007 and was completed in May 2008. The majority of work was completed in the fall of 2007; however, an unusually wet winter caused significant damage to some of the structures. All damaged structures were reinforced and repaired in spring 2008 with a significant increase in material sizes.

5.0 SUMMARY

The Highland Park drain is fed by agricultural drainage tiles from approximately 96 acres which drains into Little Chapman Lake. The drain was severely incised in soft sediments due to the failure of an old dam that had been placed across the channel at some point in the past. The sediment that had been accumulating behind the dam was washing into the lake and creating a sediment bar. The sediment bar has recently been dredged to reduce the boating obstruction, reduce the available nutrients associated with the sediment, and eliminate the substrate for Eurasian water milfoil at this location. The Chapman Lakes Foundation and the Chapman Lakes Conservation Association teamed up to sponsor an IDNR Lake and River Enhancement project in 2006 to resolve this issue. JFNew was selected as the Design-Build contractor for the Highland Park Drain stabilization Project. Nine check dams and approximately 90 feet of direct bank stabilization were constructed in approximately 1000 feet of the seasonal to intermittent drainage known as Highland Park Drain. The check dams will become fully functional after a number of years after the rock voids are filled with sediment and debris. The check dams will increase the frequency of flooding in the floodplain, which in turn will reduce the scour potential on the remainder of the eroding stream banks and cause sediment to settle in the floodplain before it reaches Little Chapman Lake.

6.0 LITERATURE CITED

Ferguson, B.K. and T. Deak. 1994. Role of urban storm-flow volume on local drainage problems. J. water Res. Planning and Management. 120:523-530.

J.F. New and Associates, Inc. 2006. Lozier and Highland Park drain Study. Loose-leaf publication. Walkerton, Indiana.

APPENDIX A

DESIGN PLANS

HIGHLAND PARK DRAIN
CHAPMAN LAKE

Kosciusko County, Indiana

EROSION CONTROL PROJECT

APRIL, 2007

JFNew
http://www.jfnew.com

Corporate/Northern Indiana
708 Roosevelt Road
Walkerton, Indiana 46574
574-586-3400 fax 574-586-3405

Central Indiana
6640 Parkdale Place, Suite N
Indianapolis, Indiana 46054
317-386-1092 fax 317-386-1088

Western Michigan
51101 Marcell Avenue
West Olive, Michigan 49460
616-240-1453 fax 616-847-4670

Ohio
11159 Lunken Drive
Cincinnati, Ohio 45241
513-469-2402 fax 513-469-2404

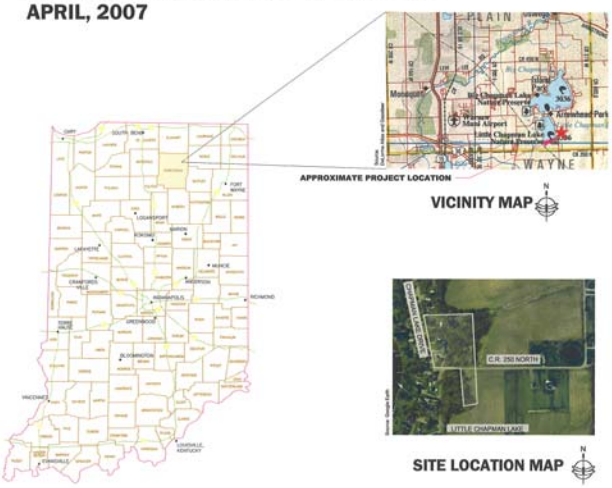
Eastern Michigan
905 S. Main Street, Suite 1
Ann Arbor, MI 48104
734-222-9600 fax 734-222-9605

Illinois
9605 Geiger Road, Unit A
Monee, Illinois 60449
708-534-3450 fax 708-534-3450

Wisconsin
1402 Pankratz Street, Suite 303
Madison, Wisconsin 53704
608-240-1453

SHEET INDEX

SHEET	DESCRIPTION
1	COVER
2	SITE PLAN
3	DETAILS



Our mission is to provide the highest quality drainage services to our clients, while positively impacting the environment, promoting the conservation of natural resources, through prosperity and stewardship.

REVISION

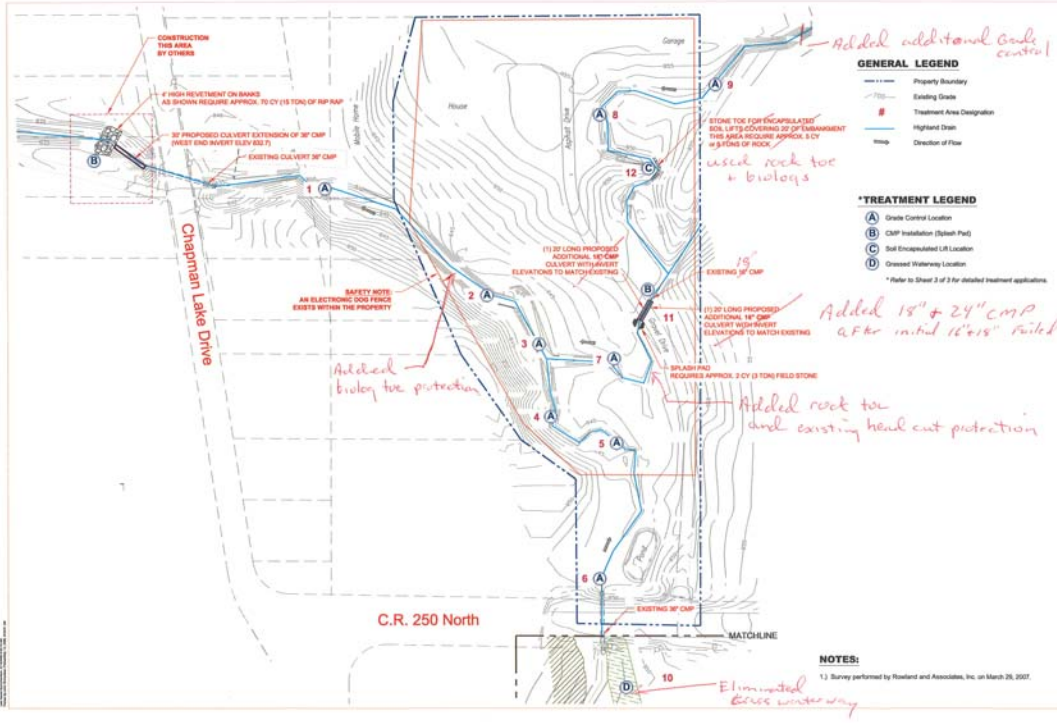
May 5, 2008 AS-BUILT

COVER
Highland Park Drain
Erosion Control Project
Chapman Lake
Kosciusko County, Indiana

DRAWN BY: CCG
DESIGNED BY: JBR
DATE: 11APR07
JOB NO: 990401-12

As-Built

DRAWING NO.
1
1 OF 3



NOTES:

1.) Survey performed by Rowland and Associates, Inc. on March 29, 2007.

JFNew

REVISION

May 5, 2008 AS-BUILT

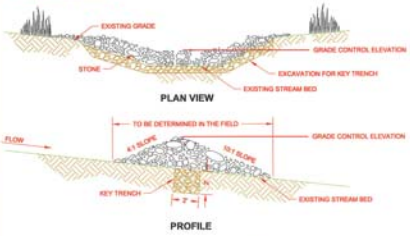
SITE PLAN
Highland Park Drain
Erosion Control Project
Chapman Lake
Kosciusko County, Indiana

DRAWN BY: CCG
DESIGNED BY: JBR
DATE: 11APR07
JOB NO: 990401-12

As-Built

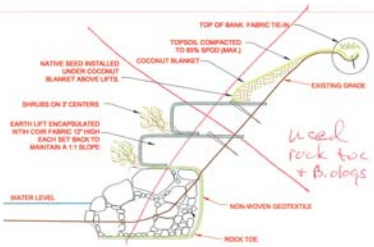
DRAWING NO.
2
2 OF 3

NOTE:
KEY STONE INTO CHANNEL BANKS AND EXTEND IT BEYOND THE ABUTMENTS TO PREVENT FLOW AROUND DAM.

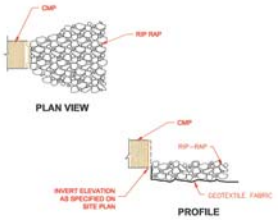


A TYPICAL GRADE CONTROL

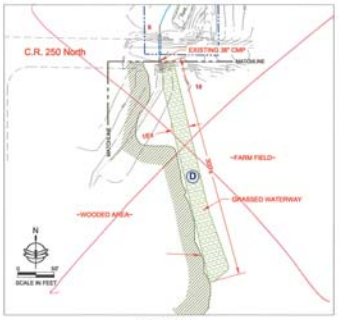
GRADE CONTROL ELEVATIONS	
TREATMENT AREA	ELEVATION
1	838.0
2	841.0
3	842.0
4	843.5
5	845.0
6	846.0
7	844.8
8	851.1
9	853.0



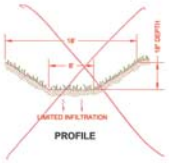
C TYPICAL SOIL ENCAPSULATED LIFT



B TYPICAL CMP INSTALLATION



PLAN VEW



D GRASSED WATERWAY

Eliminated

NOT TO SCALE

JFNew

REVISION

May 5, 2015

DETAILS
Highland Park Drain
Erosion Control Project
Chapman Lake
Kosciusko County, Indiana

DRAWN BY: CCD
DESIGNED BY: JBR
DATE: 11/APR/07
JOB NO: 98040-12

As-Built

DRAWING NO.
3
3 OF 3

APPENDIX B

PERMITS

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
INDIANAPOLIS REGULATORY OFFICE
9799 BILLINGS ROAD
INDIANAPOLIS, INDIANA 46216-1055
http://www.lrl.usace.army.mil

August 6, 2007

Operations Division
Regulatory Branch (North)
ID No. LRL-2007-637-trs

Mr. Gregory Hall
Chapman Lake Foundation
PO Box 776
Warsaw, IN 46581

Dear Mr. Hall:

This is in regard to your letter of May 8, 2007, concerning the proposed placement of 24 cubic yards of riprap below the ordinary high watermark of Highland Park Drain for erosion control. The site is located in Section 36, Township 33 North, Range 6 East, in Kosciusko County, Indiana. We have reviewed the submitted data relative to Section 404 of the Clean Water Act.

The Louisville and Detroit Districts issued Regional General Permit (RGP) No. 1 pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 CWA on December 15, 2004, for certain activities having minimal impact in Indiana. Since less than 0.10 acre of "waters of the United States" would be impacted by the discharge of dredged or fill material, and the work is considered to have minimal impact on the aquatic environment, your project is authorized under the provisions of the RGP. Compliance with the enclosed RGP General Conditions and the Section 401 Water Quality Certification issued by the Indiana Department of Environmental Management (IDEM) dated July 6, 2004, is required. You must provide the IDEM notification of this activity.

Upon completion of the work authorized by this RGP, the enclosed Compliance Certification form must be completed and returned to this office. This authorization is valid until December 15, 2009.

If you have any questions concerning this matter, please contact me at the above address or call 317-532-4227. Any correspondence should refer to our Identification Number LRL-2007-637-trs.

Sincerely,

Tim Smith
Project Manager
Indianapolis Regulatory Office

Enclosures
Copy Furnished: IDEM
JFNew

JFNew
From Native Seed to Ecological Solutions

708 Roosevelt Road
Walkerton, Indiana 46574
Phone: 574-586-3400 ext. 307
Fax: 574-586-3446

John B. Richardson
Senior Project Manager
email: jrichardson@jfnew.com

Corporate Office:
Walkerton, Indiana

Chicago, Illinois

Indianapolis, Indiana

Ann Arbor, Michigan

Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

COPY

May 8, 2007

Sara Slater-Atwater
Section 401 Program
IDEM- Office of Water Quality
PO Box 6015
Indianapolis, IN 46206-6015

RE: Regional Permit Application Notification
Highland Park Drain Restoration
Chapman Lakes Foundation, Kosciusko Country, Indiana

Dear Sara:

Please find enclosed the 401 RGP notification form, project plans, and current photographs of the project area. The Chapman Lakes Foundation and Chapman Lakes Conservation Association are undertaking a project to reduce erosion from the Highland Park Drain into Little Chapman Lake. The drainage is intermittent, with flowing water approximately 10 months of the year. The open channel section is less then 600 feet long originating at the end of a drainage tile outlet on the south side of CR 250 North.

The proposed project includes 9 small rock grade control riffles, 20 feet of soil encapsulated lift bank stabilization, and the addition of two 16-inch culverts under an existing residential driveway. A total of 24 cubic yards of field stone will be installed below the OHWM for the entire project. No wetlands will be affected by this project.

Construction is proposed for late June or July 2007. Please contact me directly if you need additional project details.

Sincerely,

John B. Richardson

Encl: 401 Regional Permit Notification, plans, photographs

Cc: Greg Hall – Chapman Lake Foundation
Tom Ross – Chapman Lake Conservation Association
Tim Smith – ACOE

Section 401 WQC Regional General Permit Notification

State Form 51937 (10-04)
Indiana Department of Environmental Management

INSTRUCTIONS: *1. Read the instruction sheet before filling out this form.*
2. All sections of this two page form must be complete.

UNITED STATES POSTAGE
PITNEY BOWES
$ 000.95⁰
02 1P
0002172589 MAY 08 2007
MAILED FROM ZIP CODE 46574

U.S. POSTAL SERVICE CERTIFICATE OF MAILING
MAY BE USED FOR DOMESTIC AND INTERNATIONAL MAIL, DOES NOT PROVIDE FOR INSURANCE–POSTMASTER
Received From:
JFNew - John Richards
708 Roosevelt Rd
Walkerton IN 46574
One piece of ordinary mail addressed to:
Sara Blaker - Attention
Section 401 Program - IDEM
PO Box 6015
Indianapolis IN 46206-6015
MAY - 8 2007
WALKERTON IN 46574
PS Form 3817, January 2001

FOR IDEM USE ONLY	Date Rec'd:	IDEM

Applicant Information

Applicant: Chapman Lakes Foundation	Agent: JFNew and Associate
Contact person: Gregory Hall	Contact person: John Richardson
Address: PO Box 776 Warsaw, IN 46581	Address: 708 Roosevelt Road Walkerton, IN 46574
Phone: (260) 414-1164	Phone: (574) 586-3400
E-mail:	E-mail: jrichardson@jfnew.com

Project Location

County: Kosciusko		Nearest Town: Warsaw
Quad Name: Leesburg	Township: 33N	Range: 6E

Project Address:
3028 E 250N
Warsaw, IN 46582

Existing Conditions

Wetlands: ☐ YES ☒ NO	Total acreage onsite:
Wetland type: ☐ Emergent ☐ Scrub-shrub ☐ Forested	
Stream: ☒ YES ☐ NO	Stream name: Highland Park Drain
Open water: ☐ YES ☒ NO	Open water type:

Project Impacts

Activity Description:
The Highland Park Drain is an intermittent tributary to Little Chapman Lake with approximately 96 acres of drainage. The proposed project is intended to reduce erosion from the agricultural field above the drainage and from in-stream erosion. Proposed impacts to the waterway include nine check dams with an average of 2 cubic yards of field stone in each, culvert additions under an existing driveway crossing with an associated field stone splash pad (approximately 1 cubic yard), 20 feet of bank stabilization using a soil encapsulated lift and rock toe (4 cy), a grassed waterway in an existing farm field (0 discharge into existing waterway). No temporary access roads or other fill activities will be required to implement this project.

Purpose of project:
The proposed project is intended to reduce erosion from the agricultural field above the drainage and from in-stream erosion.

Acres of wetland impact
Emergent: 0 Scrub/shrub: 0 Forested: 0

Linear feet of stream impact: 20	Acres of open water impact: 0

Field stone below the Ordinary High Water Mark
Volume *(cubic yds. per running ft.)*: 22 Area *(sq. ft.)*: 72

Signature of Applicant - Statement of Affirmation

I certify that I am familiar with the information contained in this notification and, to the best of my knowledge and belief, such information is true and accurate. I certify that I have the authority to undertake and will undertake the activities as described in this notification. I am aware that there are penalties for submitting false information. I understand that any changes in project design subsequent to IDEM's granting of authorization to discharge to a water of the state are not authorized and I may be subject to civil and criminal penalties for proceeding without proper authorization. I agree to allow representatives of the IDEM to enter and inspect the project site. I understand that the granting of other permits by local, state, or federal agencies does not release me from the requirement of obtaining the authorization requested herein before commencing the project.

Applicant's Signature: Greg Hall **Date:** 5/7/07 (mm/dd/yyyy)

Print Name: Greg Hall **Title:** President, Chapman Lakes Foundation

Enclose copies of the following documents (ALL enclosures must be on 8.5" by 11" paper:

- ☒ Location map
- ☒ Drawings of existing site and proposed project
- ☒ At least three photos of site, labeled
- N/A Copies of all correspondence from the U.S. Army Corps of Engineers
- N/A Copy of wetland delineation report

Mail this form and attachments to:

Indiana Department of Environmental Management
Office of Water Quality
Section 401 WQC/State Isolated Wetlands Program
P.O. Box 6015
Indianapolis, Indiana 46206-6015

Please note:

1. IDEM will review this form and all attachments for completeness and accuracy. You will be contacted within thirty (30) days of the date of receipt of this form **only** if problems are identified. IDEM may require additional information to verify that the project meets all conditions of the Regional General Permit and the Section 401 WQC. If you are not contacted by IDEM within thirty (30) days of the date of receipt of this form by IDEM, your project is thereby authorized, subject to the terms and conditions of the Section 401 Water Quality Certification and its conditions. **You will not receive a written confirmation of authorization.**
2. Read **all** the terms and conditions of this regional general permit, including all U.S. Army Corps of Engineers and Indiana Department of Environmental Management conditions. Do not submit this form or commence work on the proposed project until you understand and are familiar with the limitations and restrictions of this regional general permit.
3. Consult this webpage for more information: http://www.in.gov/idem/water/planbr/401/rgp02.html

APPENDIX C

PHOTOGRAPHS

Facing downstream from junction of east tributary with main channel (above left) Facing upstream at the same junction (above right). Note width and depth of existing channel.

Facing upstream at head cut in east tributary (above left). Facing downstream at dam breach area in main channel (above right). Facing upstream on east tributary from junction (below).

Photos taken March 2007

Facing downstream at dam breach area (above left). Facing upstream at new driveway culverts.

Facing downstream (north) at new check dam on east tributary 40 feet upstream from junction with main stem (above left). Facing upstream at easternmost check dam downstream from grass waterway. Note six inch tile in background (above right). Facing upstream (east) at armored headcut and eroding bank just west of driveway (left).

Photos taken May 2008