Appendix E

Contents

Data Verification Summary

Data Verification Title: Cherokee Nuclear Station Final Foundation Field Maps and Index Map
ID Number: HRQ-FWLA-001
Date of Qualification Review Team Meeting: November 12, 2010

Quality Review Team:

Name	Sign (Initials)	Organization	Qualifications
Jim Cassidy	JRC 1 Dec 2010	**Duke Energy**	**QA/QC Verification**
John McConaghy	JMM 30NOV10	**Duke Energy**	**Engineering**
Juan Vizcaya	JV	**Enercon Services Inc.**	**Engineering**
Malcolm Schaeffer	MFS	**HDR/DTA**	**Former Duke Power Project Geologist**
Michael Gray	MGG	**FWLA**	**Project Principal Geologist**
Adam Wade	AMW	**FWLA**	**Project Geologist**

Data / Evidence Considered During the Reviews:

The contents of the files outlined in attachment 2 were reviewed for applicability and completeness.

Critical Attributes Considered During the Reviews:

Files comprise the hand drawn field maps, including index map, documenting observed foundation level mapping conducted at former Cherokee Nuclear Station (CNS) Unit 1 and portions of CNS Unit 2.

Basis for Qualification / Non-Qualification:

The data is qualified to use in WLS evaluations to document final foundation geology beneath former CNS units 1 and 2. The information documented in these files was acquired, prepared, and verified using the applicable specifications and Duke QA procedures governing at the time of gathering and preparation. The CNS final foundation field geologic maps, including index map, may be used in corroboration of information. These field maps will be used as inputs to develop a final foundation map record to support geologic evaluations as part of WLS COLA.

Is the data considered Nuclear Safety Related QA Qualified? _____Yes_____ (Yes / No)

Recommendations for Additional Qualification Activities:

None

Dissenting conclusions or comments: If the team reaches concensus, enter "None" here. Otherwise, document the dissenting view as follows:
Reviewer Name and Organization: _____
Dissenting Statement: _____None_____
_____
Signature and Date: _____

I hereby certify this Data Verification Package is complete:
Quality Review Team Lead: _____ **(Sign)** **Date:** 12/02/2010

I approve this Data Verification Package for the usage identified above:
Approved By: R.L. Morgan, Jr **(Sign)** **Date:** 12/02/2010
(Duke Project Manager or designee)

Data Verification Planning Form

Data Verification Title: Cherokee Nuclear Station Final Foundation Maps and Index Map **ID Number:** HRQ-FWLA-001

Scope of Historical Data Requiring Review:

Sixty (60) hand drawn field geologic maps at 1"=10' scale of final excavated surface of the Cherokee Nuclear Station (CNS), and one (1) hand drawn index map. Mapping performed during CNS construction from 1977 to 1982. Attachment 1 summarizes the individual field maps to be qualified . Attachment 2 contains .pdf copies of hand drawn map panels and index map. Attachment 3 contains a copy of the records transmittal. Attachment 4 contains a copy of the written mapping procedures and addendum for the final excavation mapping program.

Purpose / Applicability of Data:

These field maps will be used as inputs to develop a final foundation map record to support geologic evaluations as part of WLS COLA.

Methods of Verification (X):

Peer Review _____ Data Corroboration **X** Confirmatory Testing _____

Rationale:

The field maps generated for this project were produced using approved standards and procedures by Duke Power Company, now Duke-Energy. They represent an in-process product with status as of the time work on the Cherokee project was stopped. A copy of the Duke Power mapping procedure and addendum is provided in Attachment 4. Current-era work will compile information from these field maps to support licensing and construction of Lee Nuclear Station

Need for Data Qualification Affirmed By: Michael Gray **Date:** 5/19/2010

FWLA Project Manager (or designee)

Required Organizations for Verification:

FWLA with support from Duke-Energy and Enercon.

Duke Approval of Scope and Methods Used: RL Morgan Jr RL Morgan, Jr **Date:** 12/02/2010

Duke Project Manager (or designee)

Attachments:

Attachment 1 Listing of Field Maps to be Qualified
Attachment 2 CNS Final Foundation Field Maps and Index Map
Attachment 3 Record Transmittals
Attachment 4 Duke Power Company Mapping Procedures and Addendum

Attachment 1

Listing of Field Maps to be Qualified

Duke Energy Records Designation					CNS Records Designation	CNS Map Phase	
Folder Name	File Name/ Map Panel #	Date of Transmittal	Rescanned Map Panel File Name	Date of Transmittal	Map Panel Designation	Phase II map 1"=10'	Inset map 1"=10'
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	21.TIFF	March 23 2007			CK10-01A		X
CK10-02	22.TIFF	March 23 2007			CK10-02B	X	
	23.TIFF	March 23 2007			CK10-01B	X	
	24.TIFF	March 23 2007			CK10-02D	X	
	25.TIFF	March 23 2007			CK10-02A	X	
	26.TIFF	March 23 2007			CK10-02F	X	
	27.TIFF	March 23 2007			CK10-02E	X	
	28.TIFF	March 23 2007			CK10-020	X	
CK10-03	29.TIFF	March 23 2007			CK10-03A	X	
	30.TIFF	March 23 2007			CK10-03B	X	
	31.TIFF	March 23 2007			CK10-03C	X	
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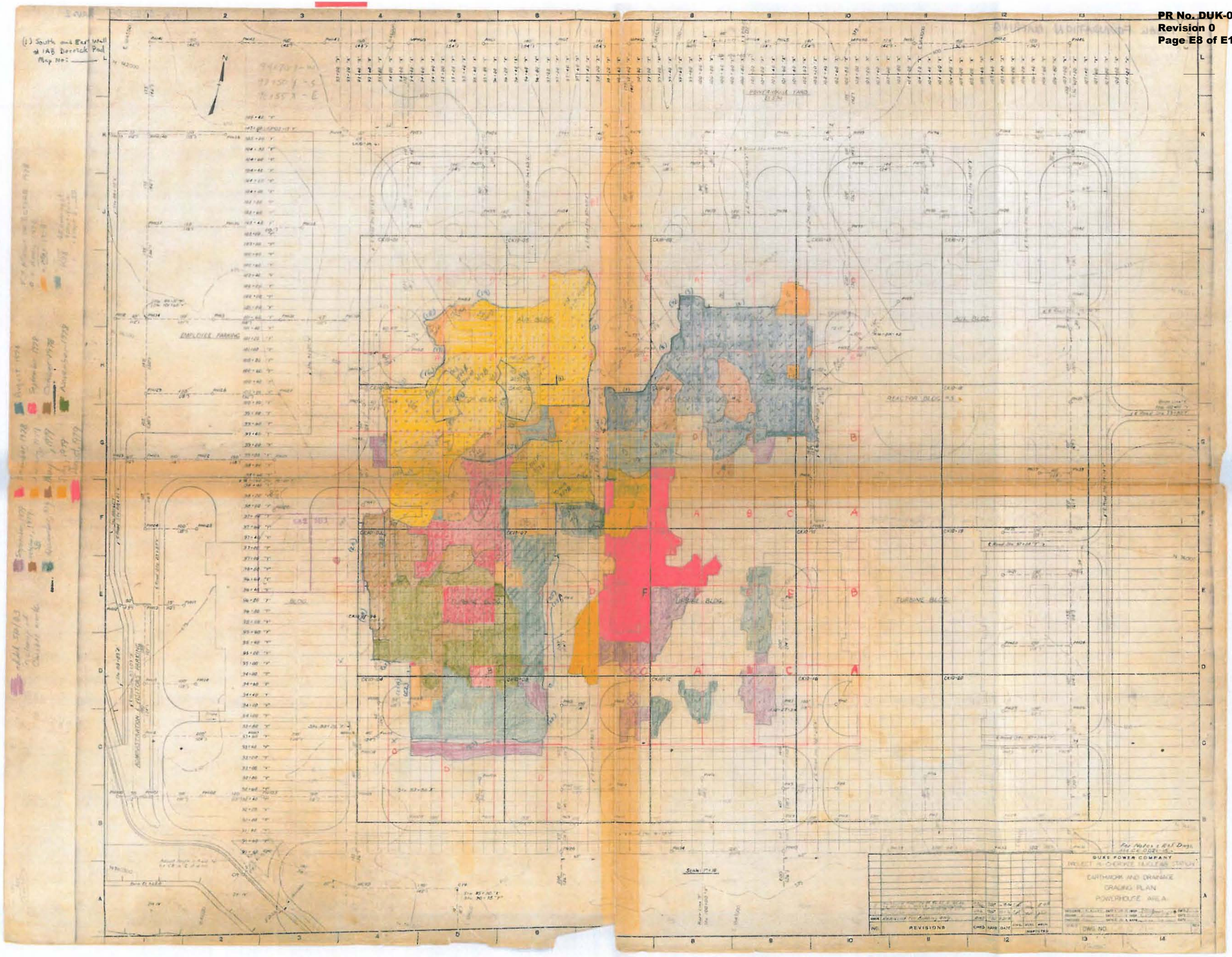
	Final Foundation Index Map (AKA Binder2 2).PDF	November 23 2006			CK-0021-05A Rev.2	NA	NA

ATTACHMENT 2

CNS Final Foundation Field Maps and Index Map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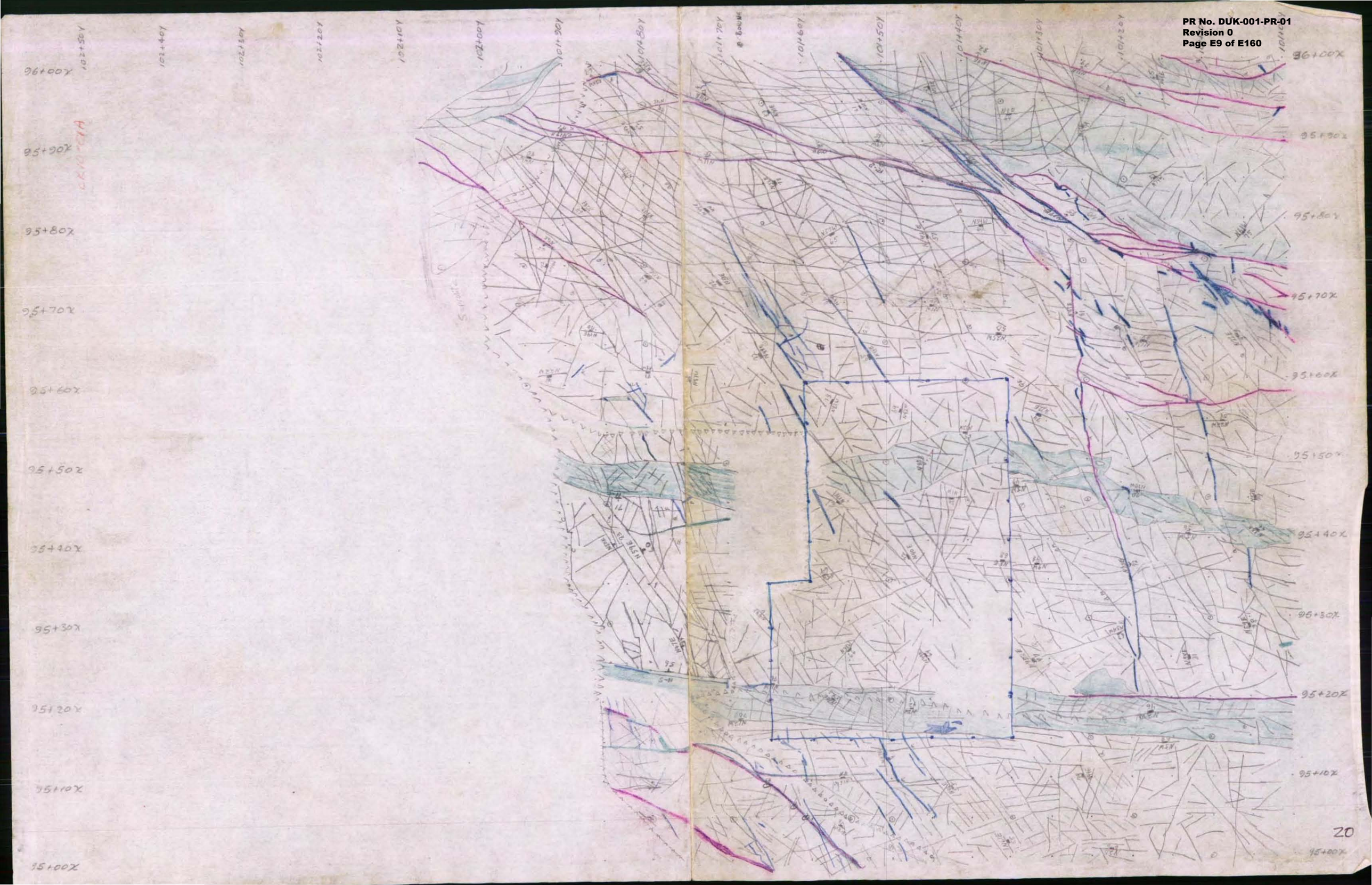
AUX. BLDG.
REACTOR BLDG.
TURBINE BLDG.
DUKE POWER COMPANY
PROJECT W-CHEROKEE NUCLEAR STATION
EARTHWORK AND DRAINAGE
GRADING PLAN
POWERHOUSE AREA
REVISIONS
DWG. NO.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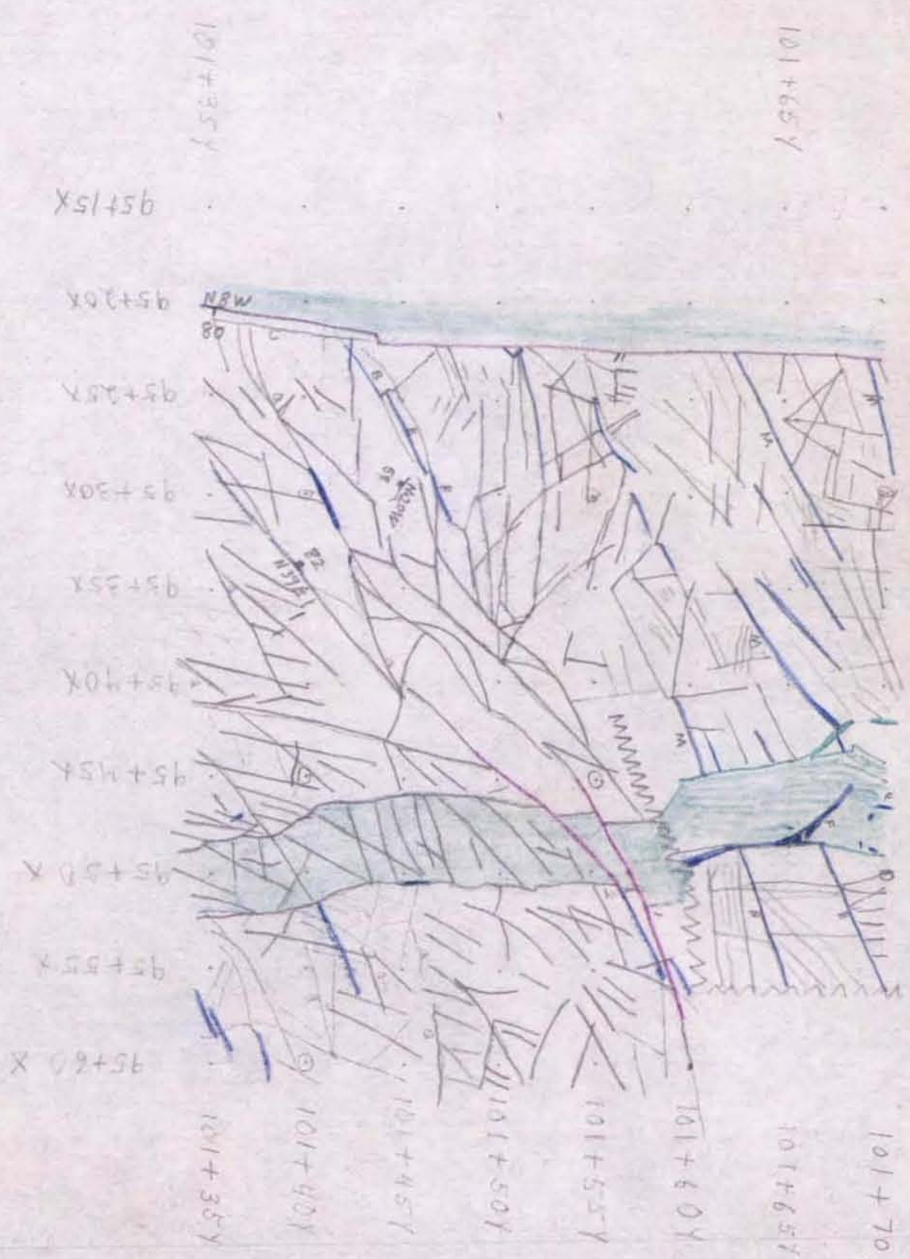
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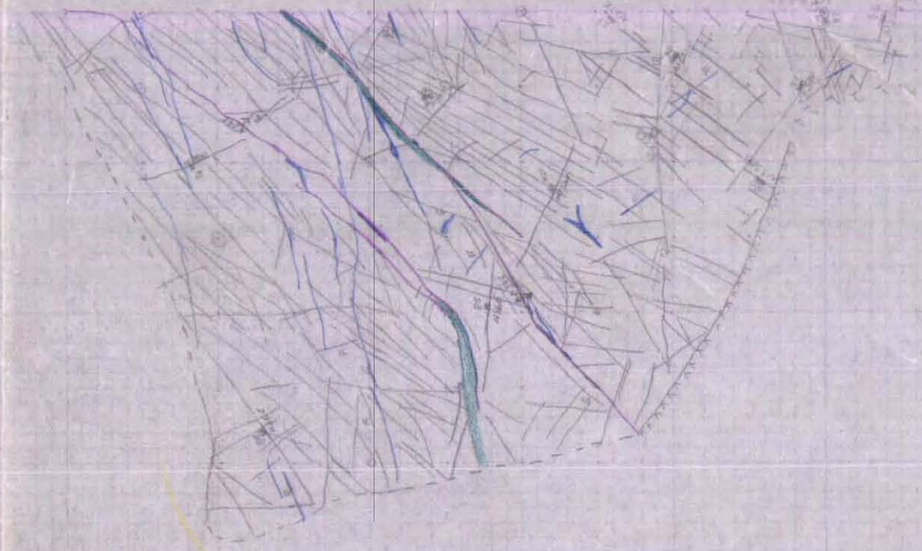

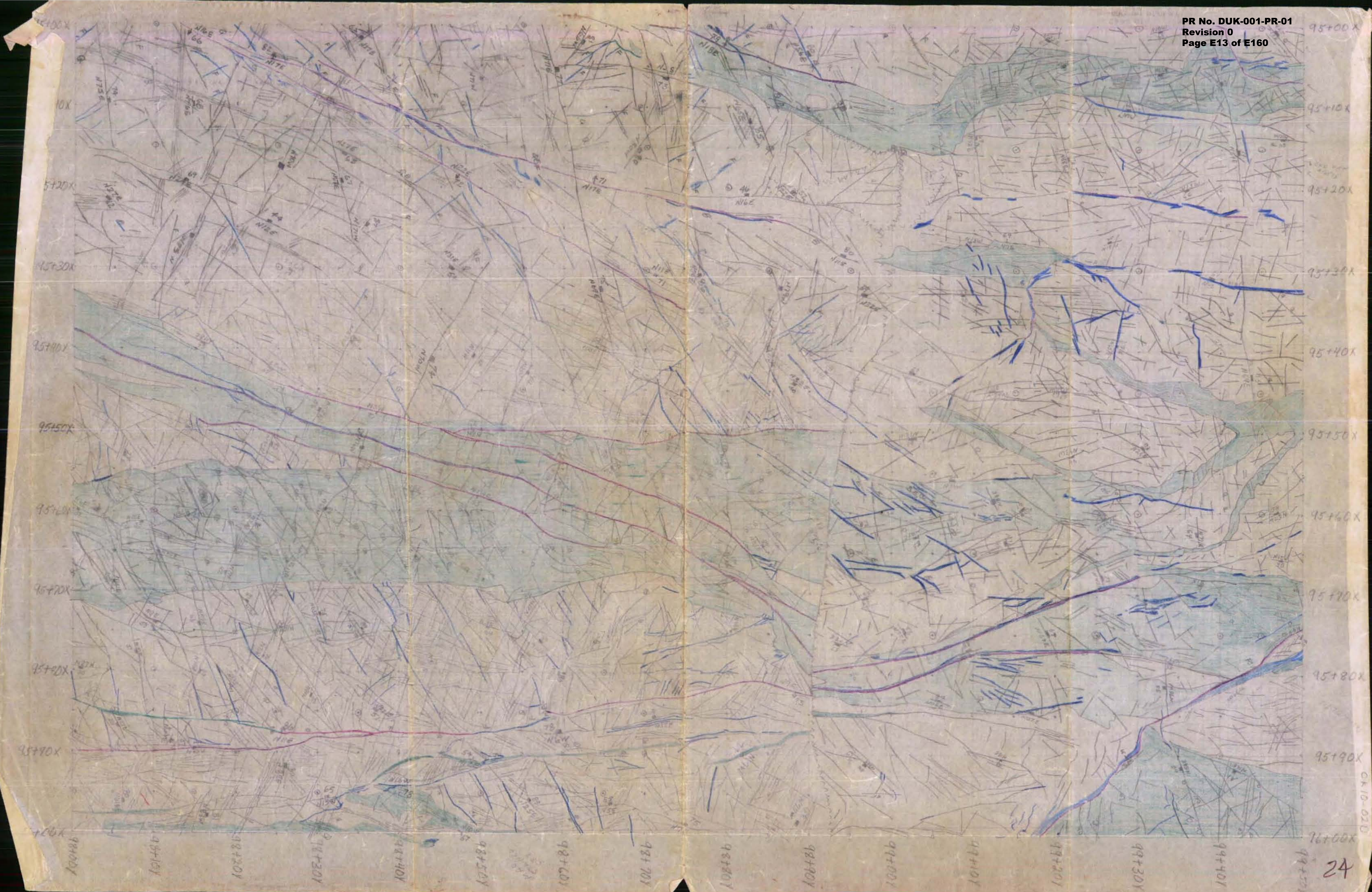
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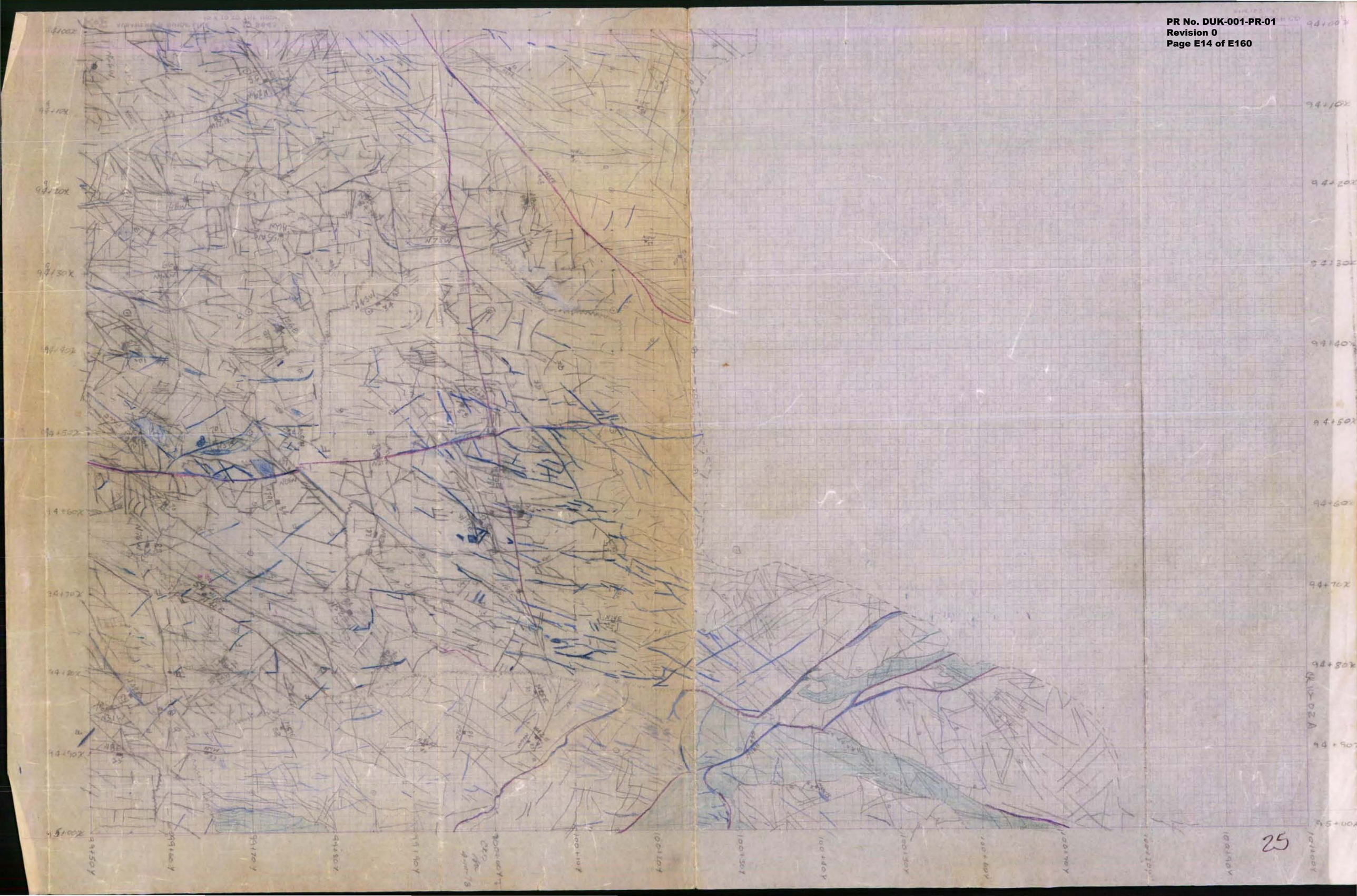

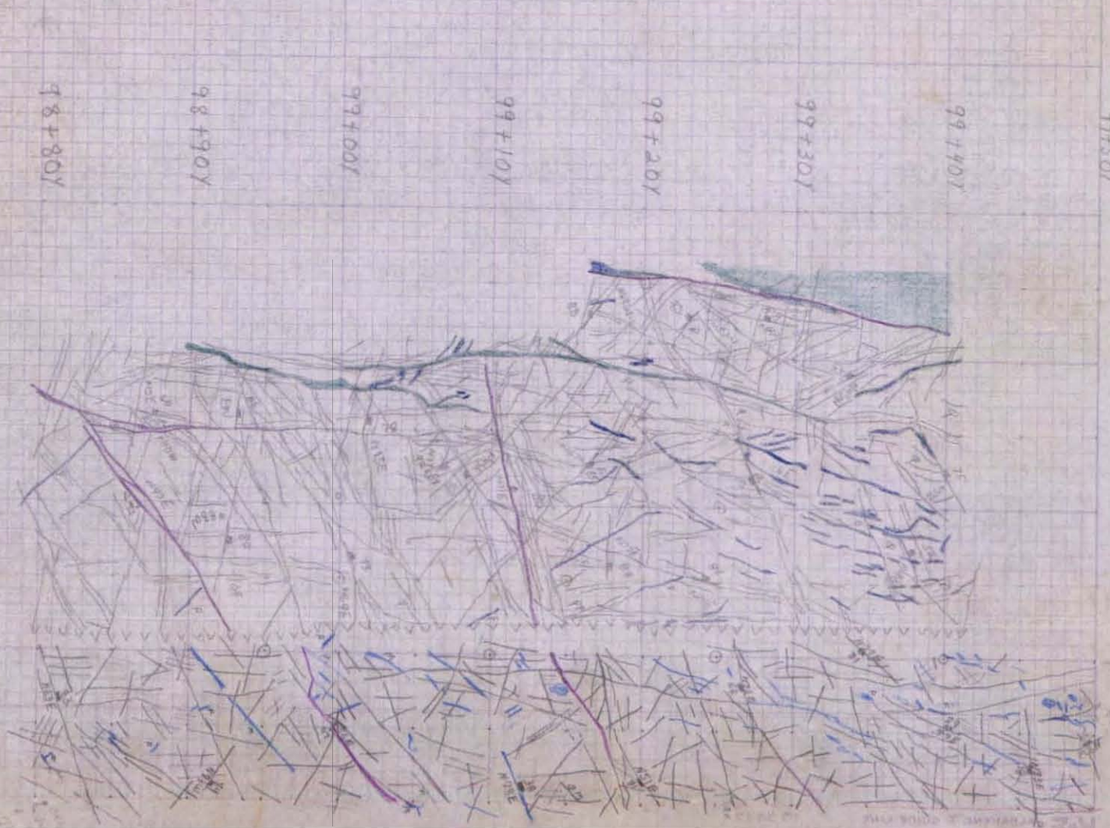
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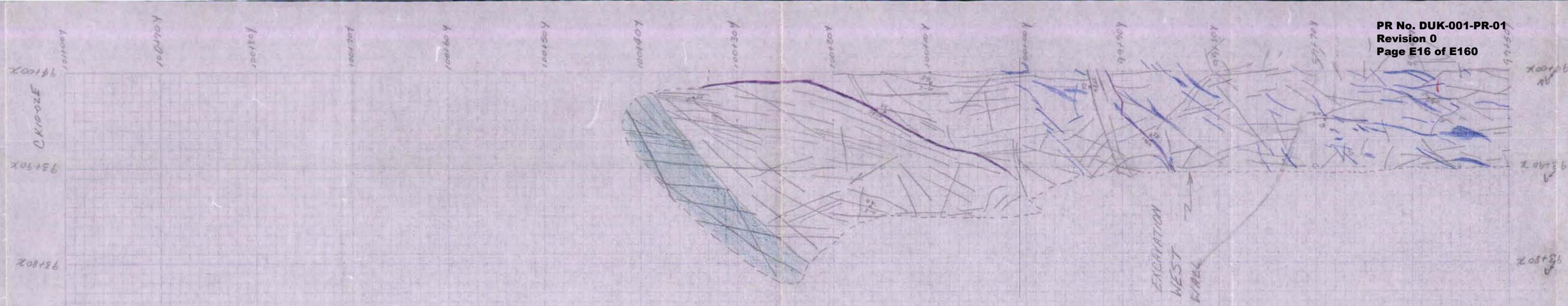
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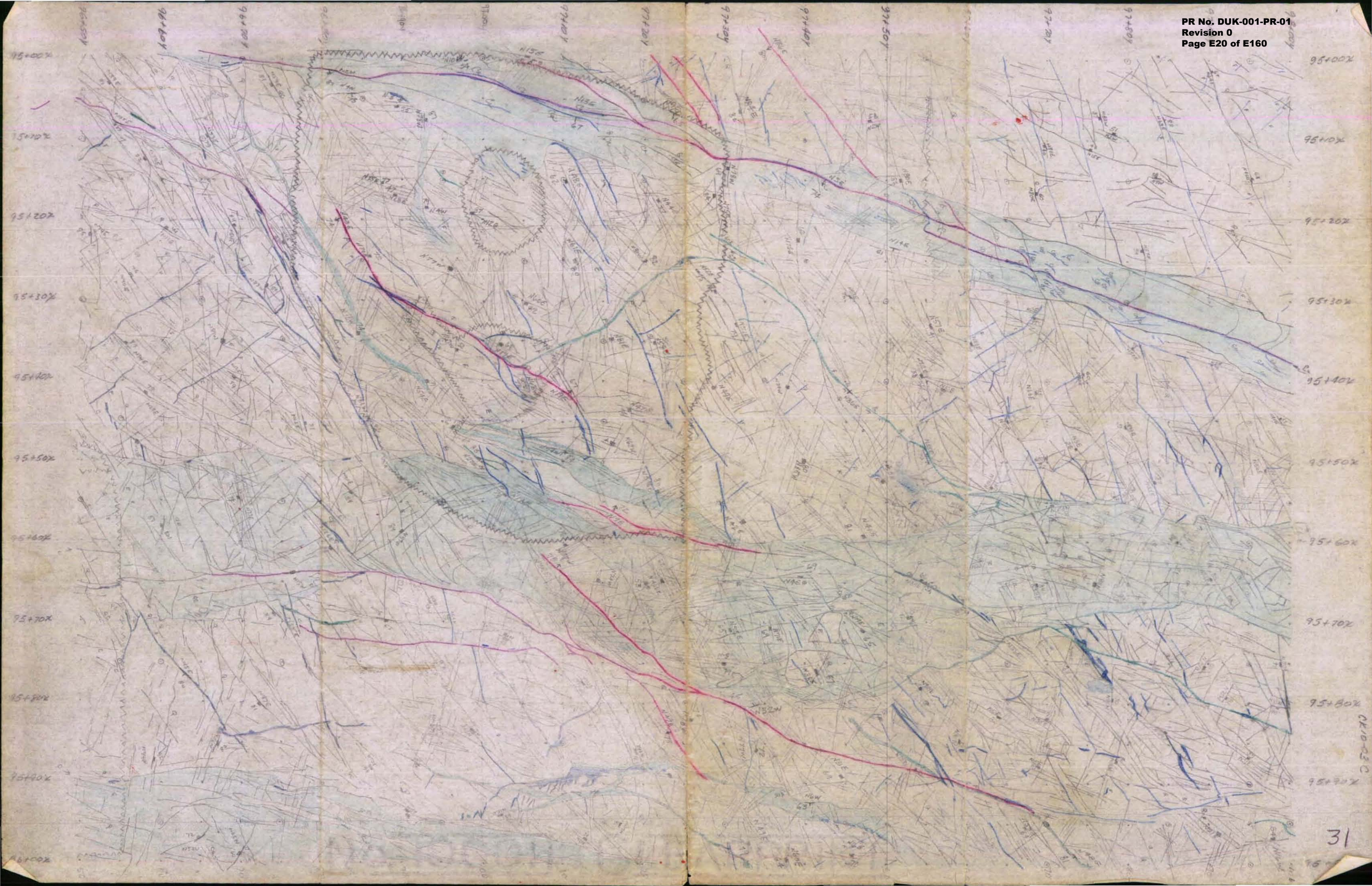
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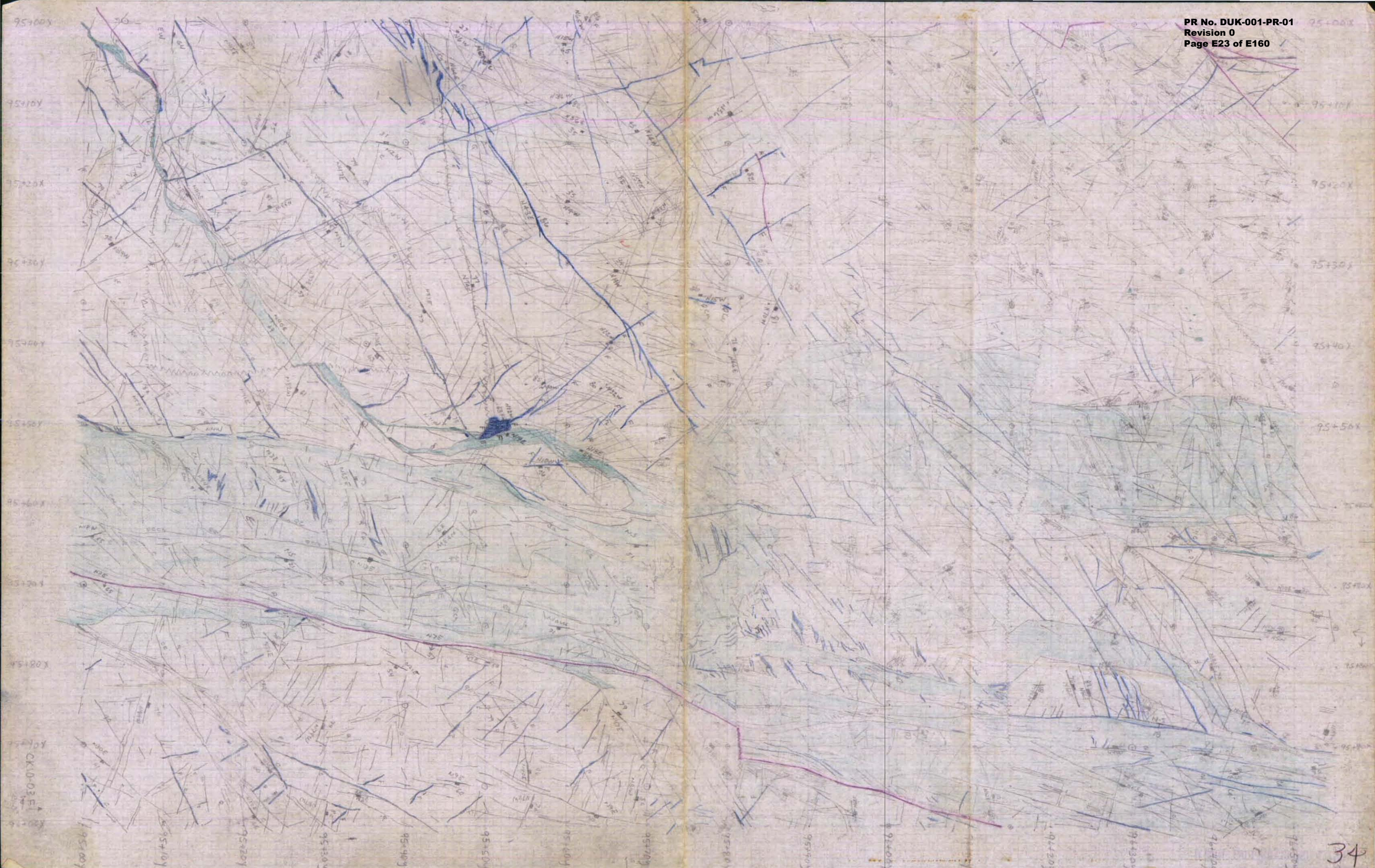

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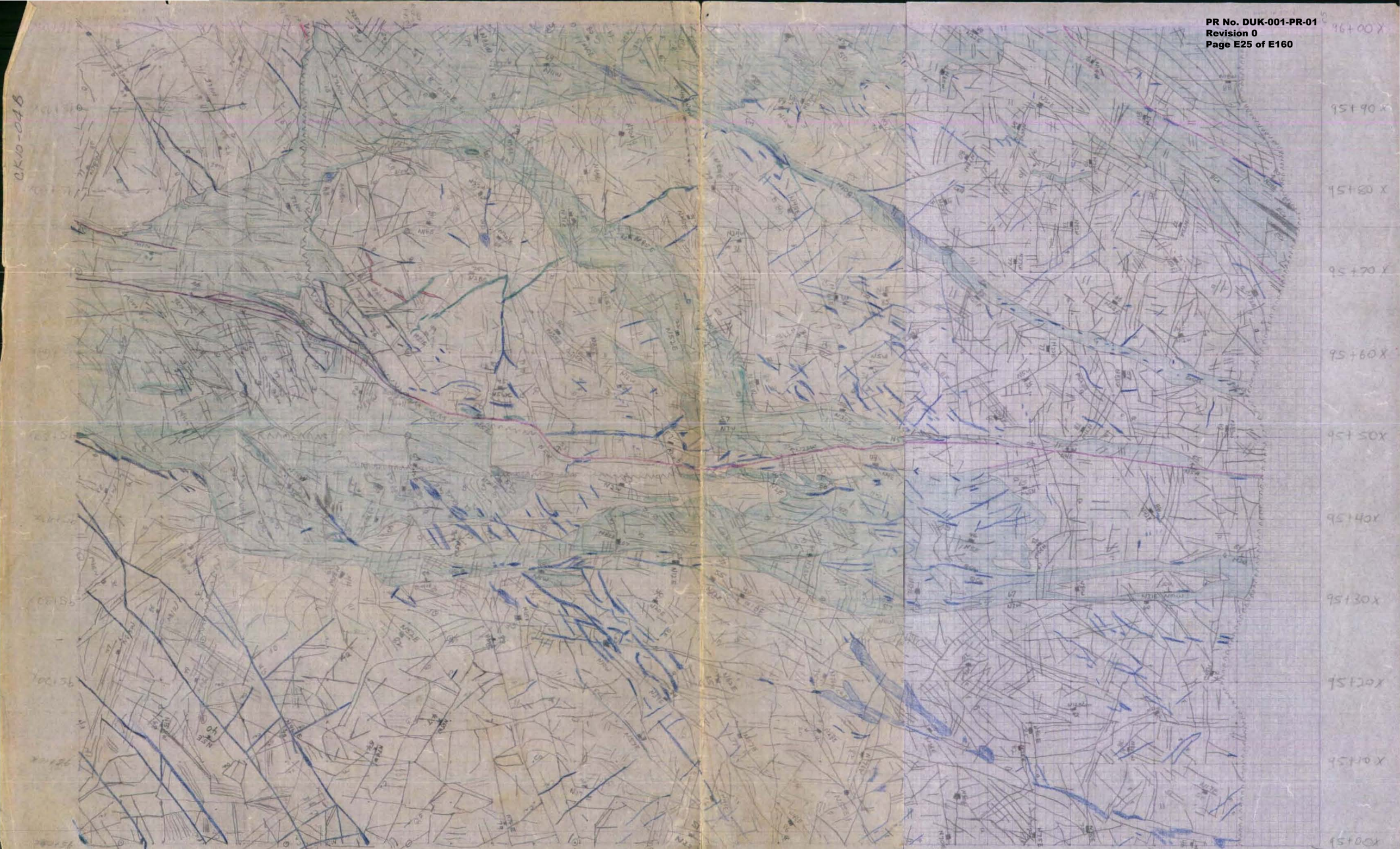
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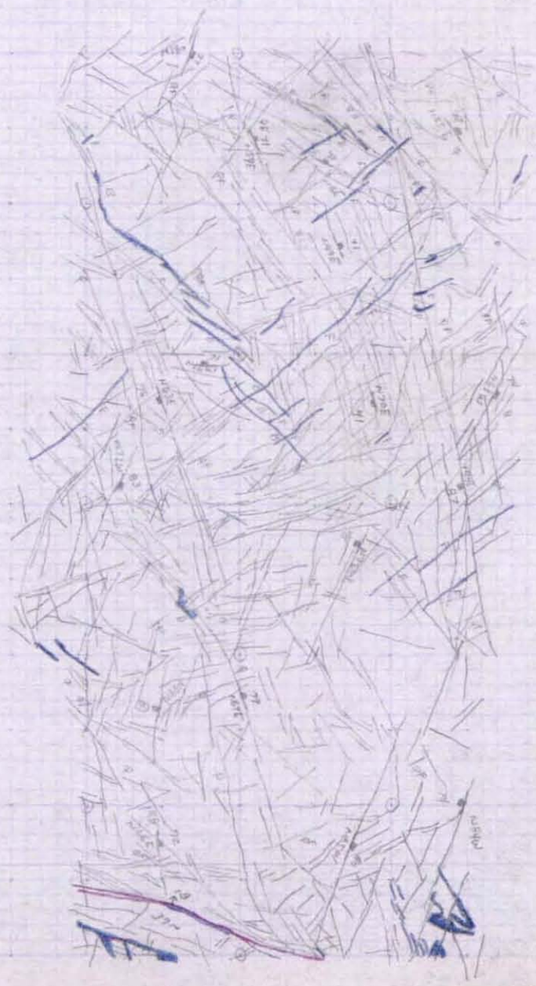

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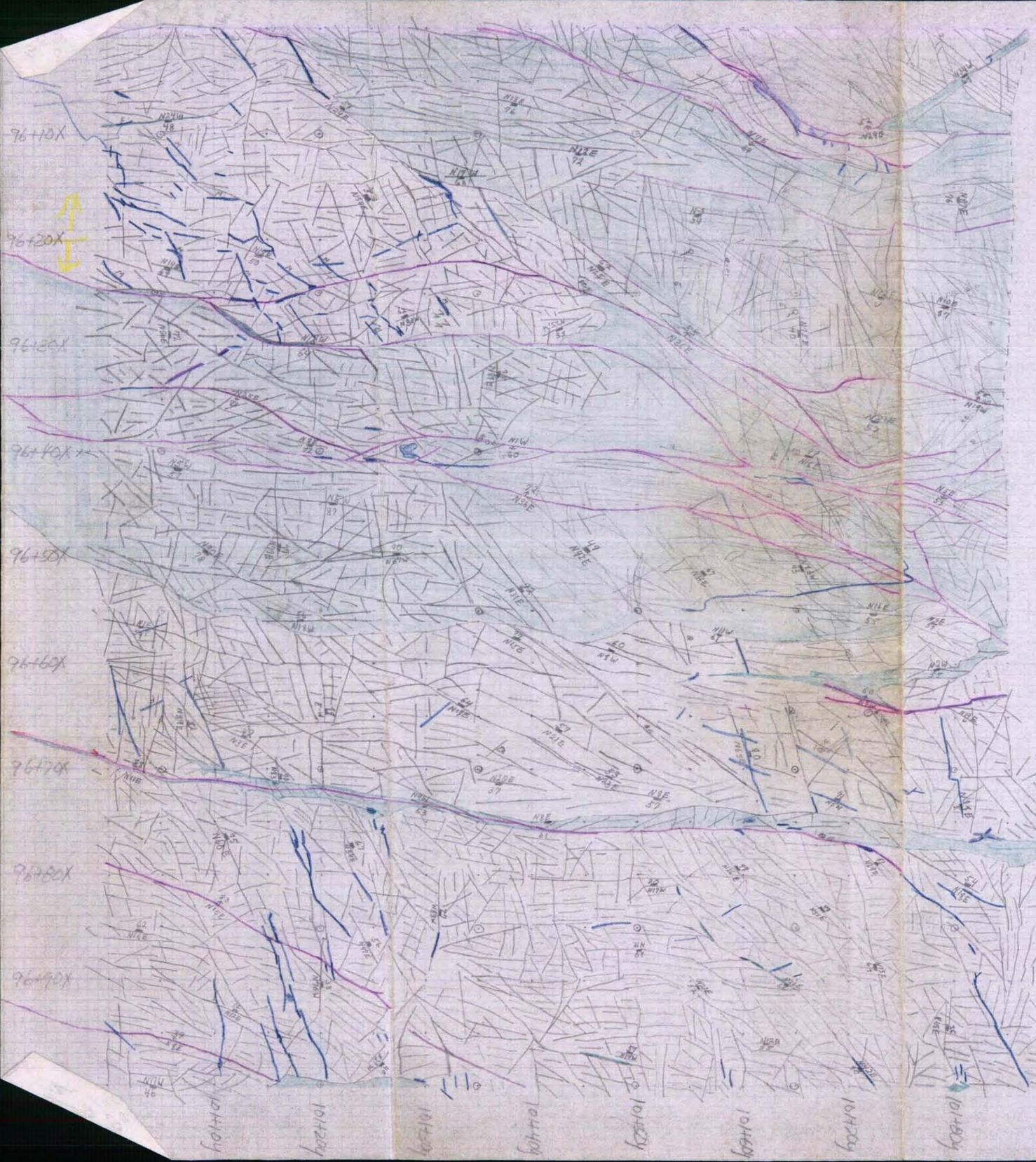
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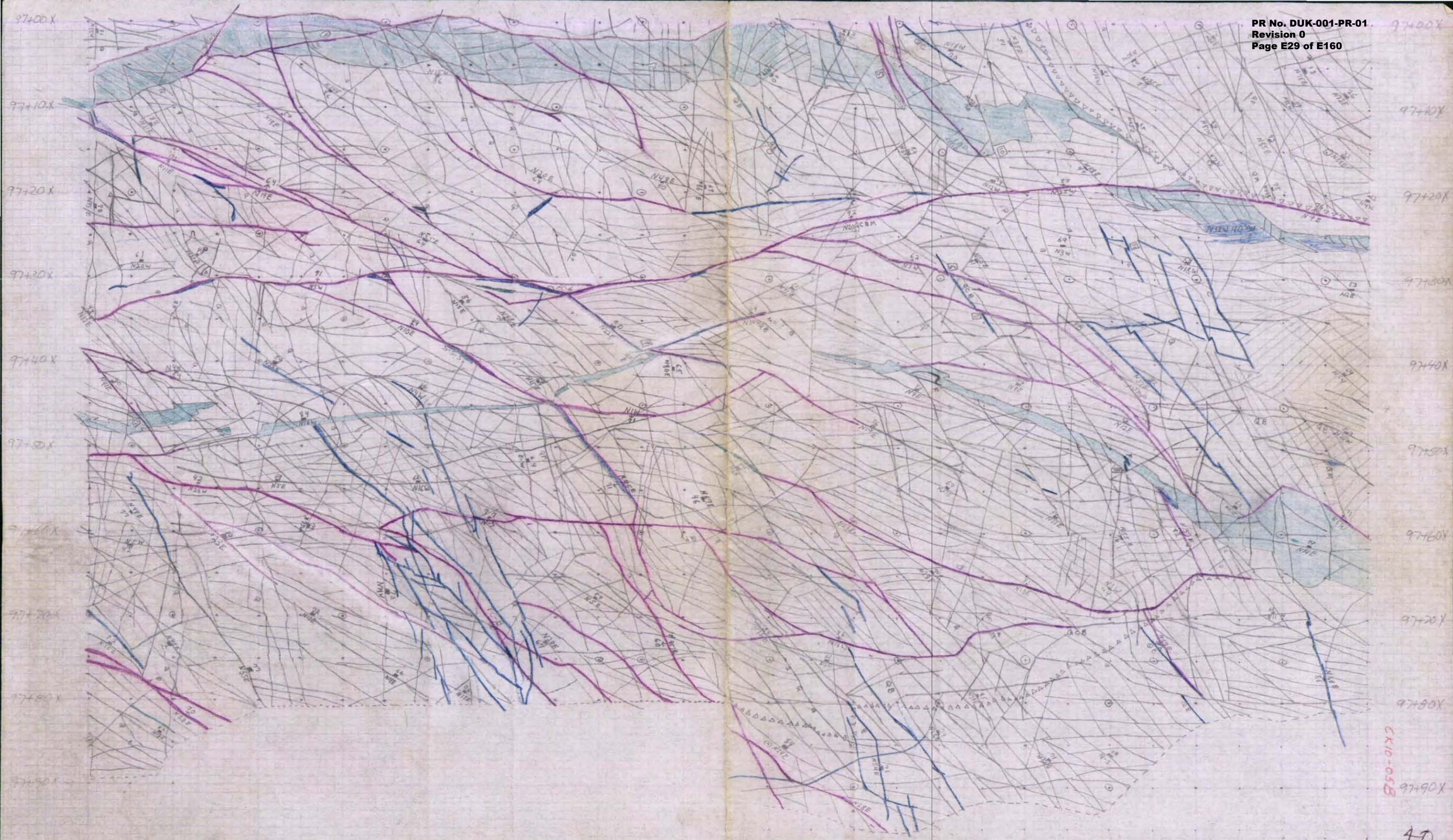
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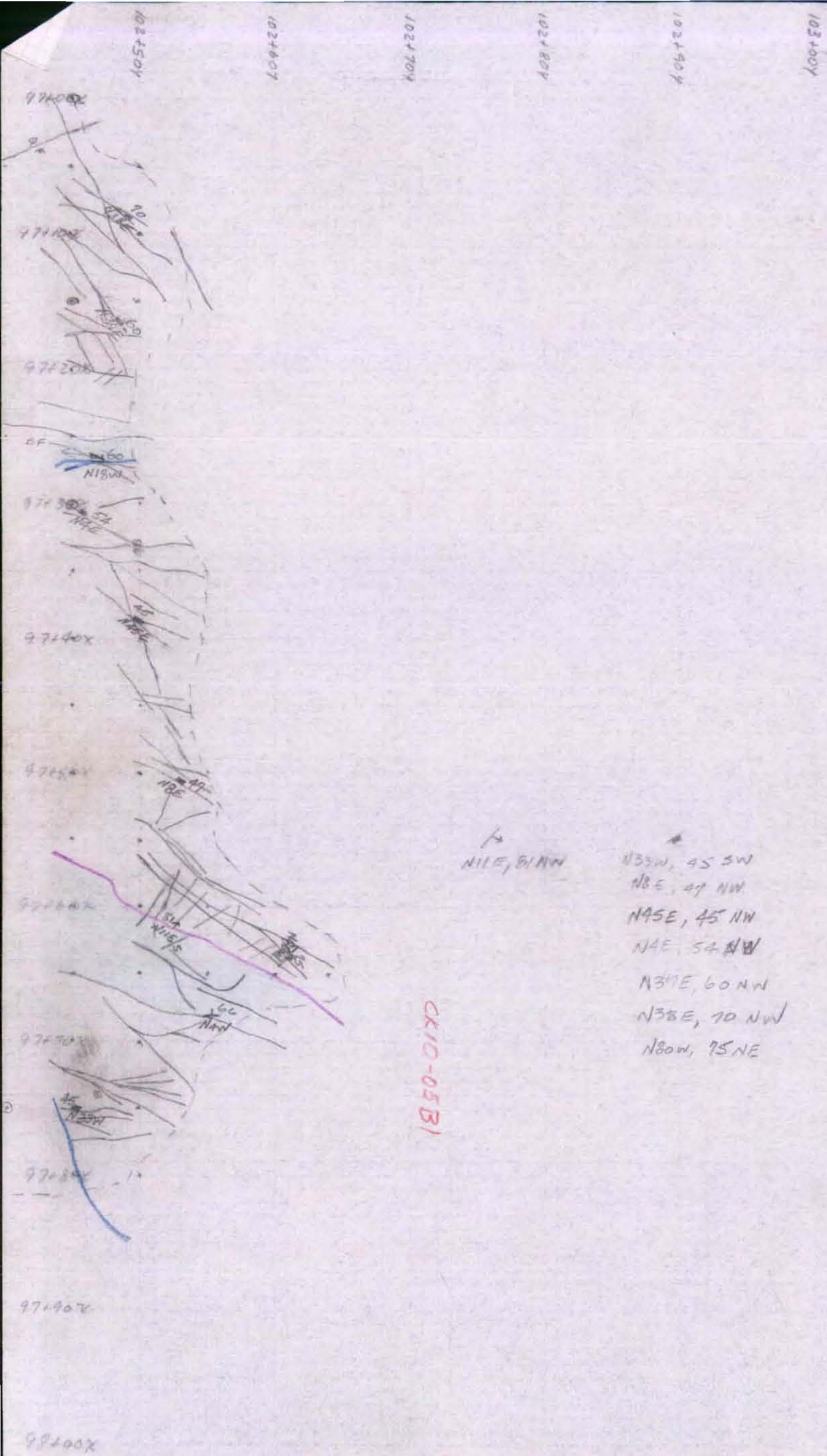

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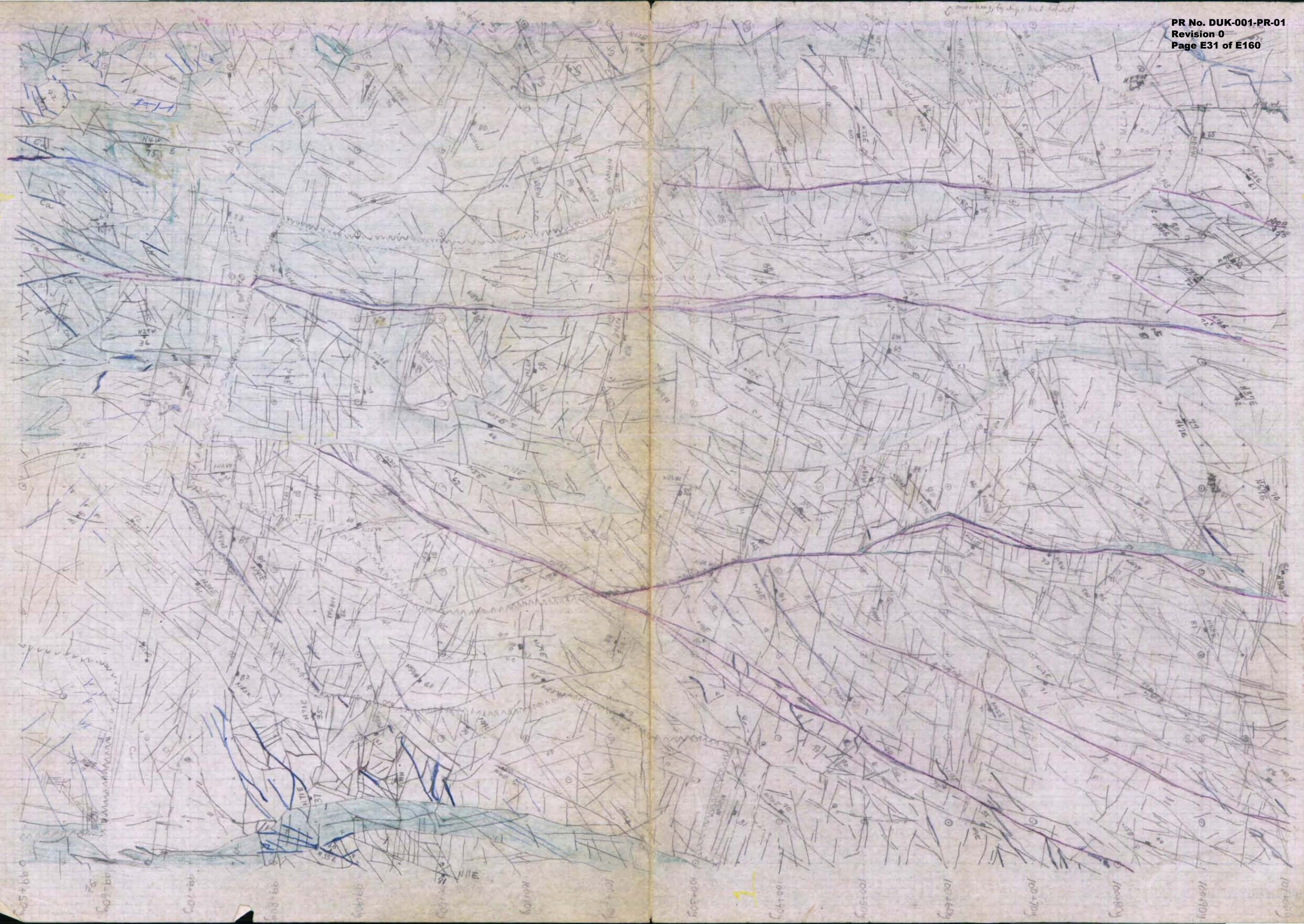

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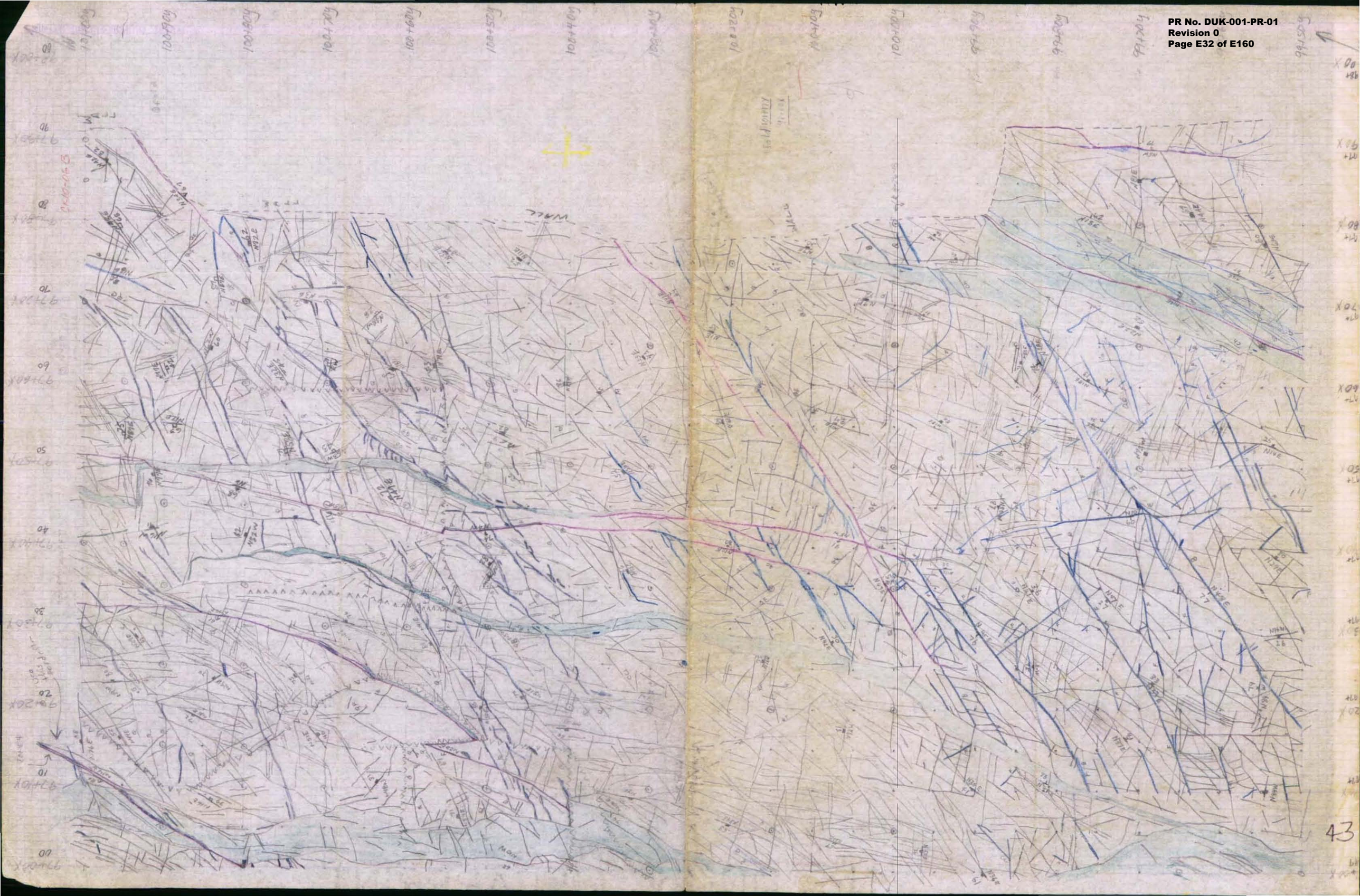


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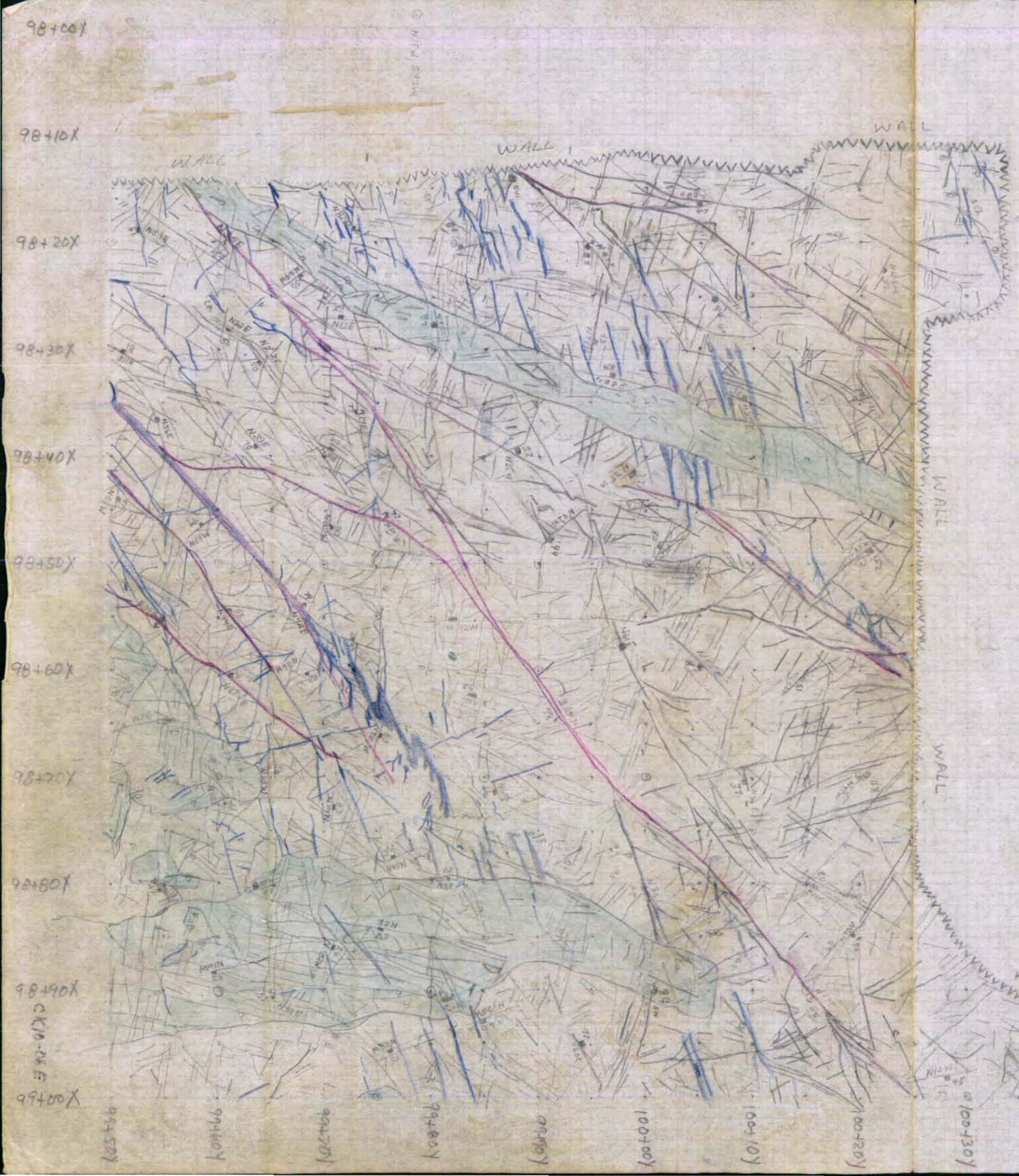
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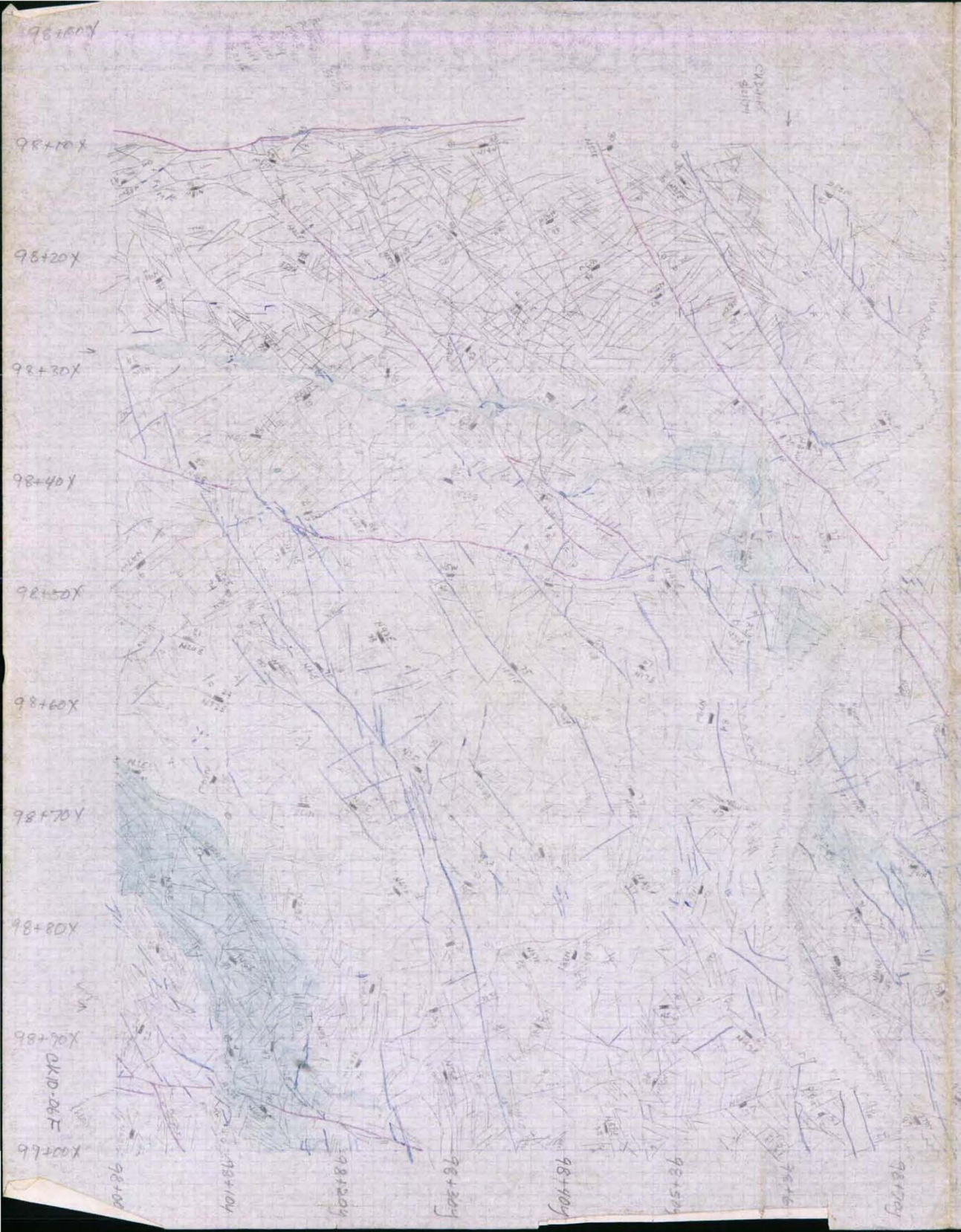
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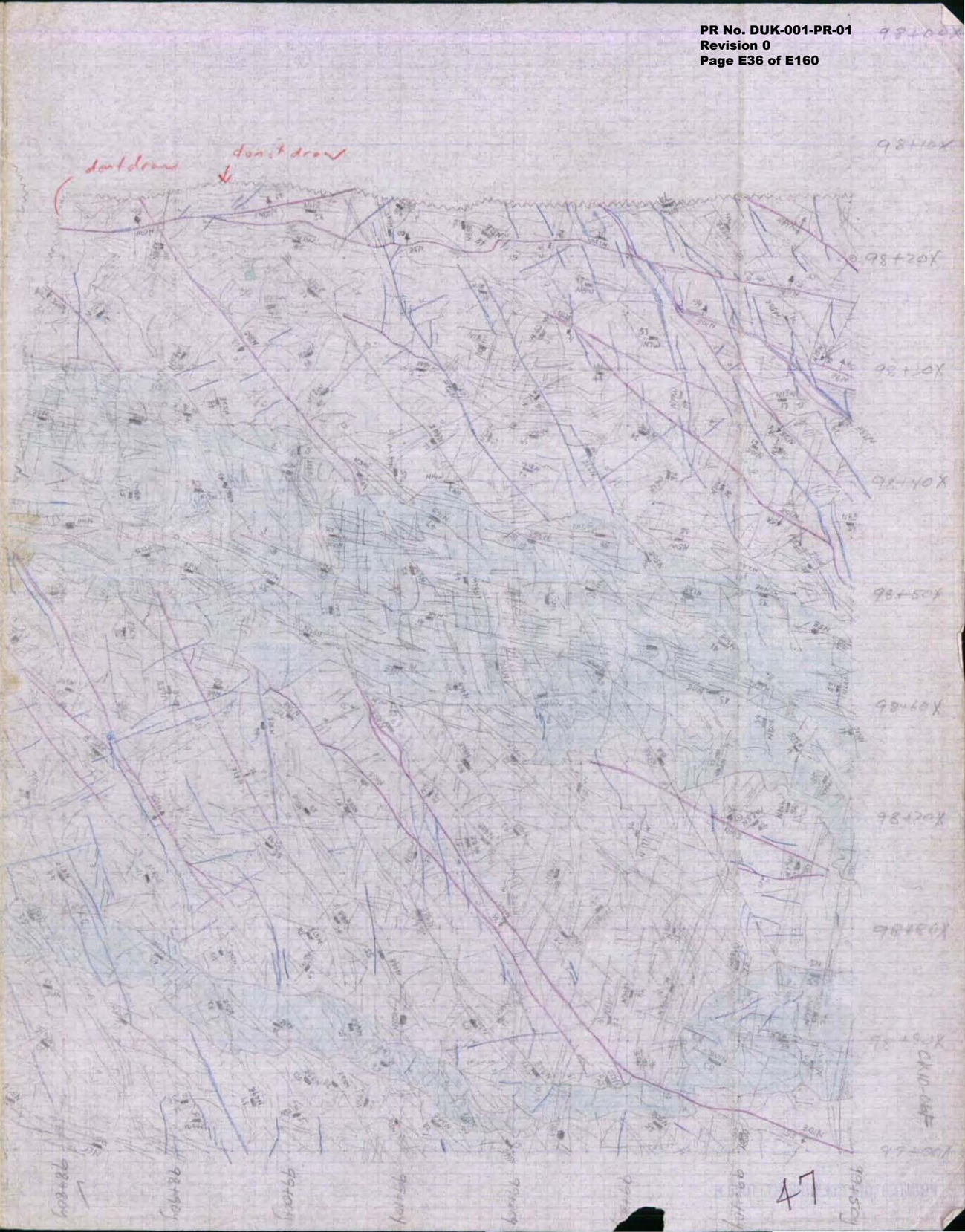
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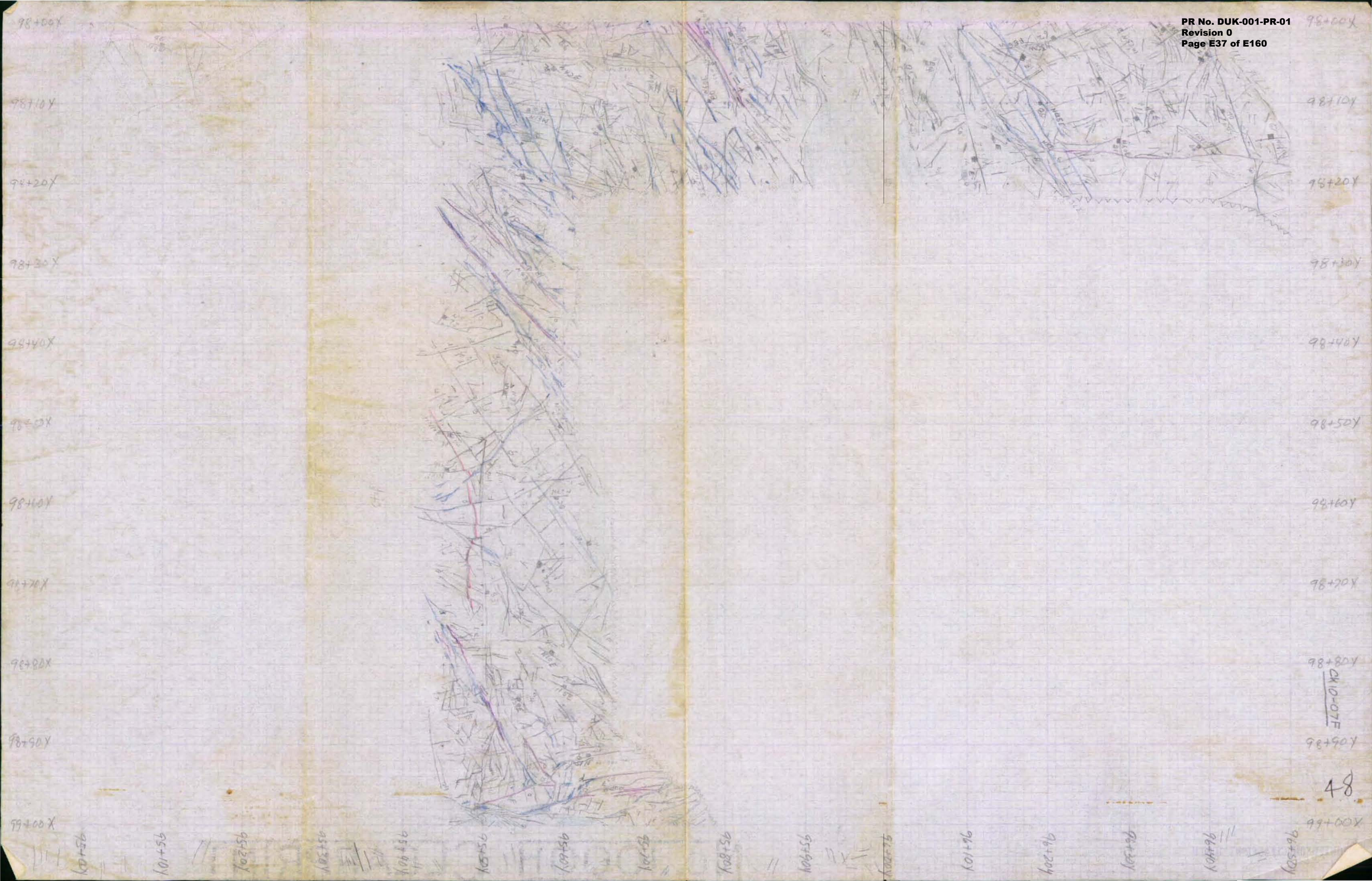
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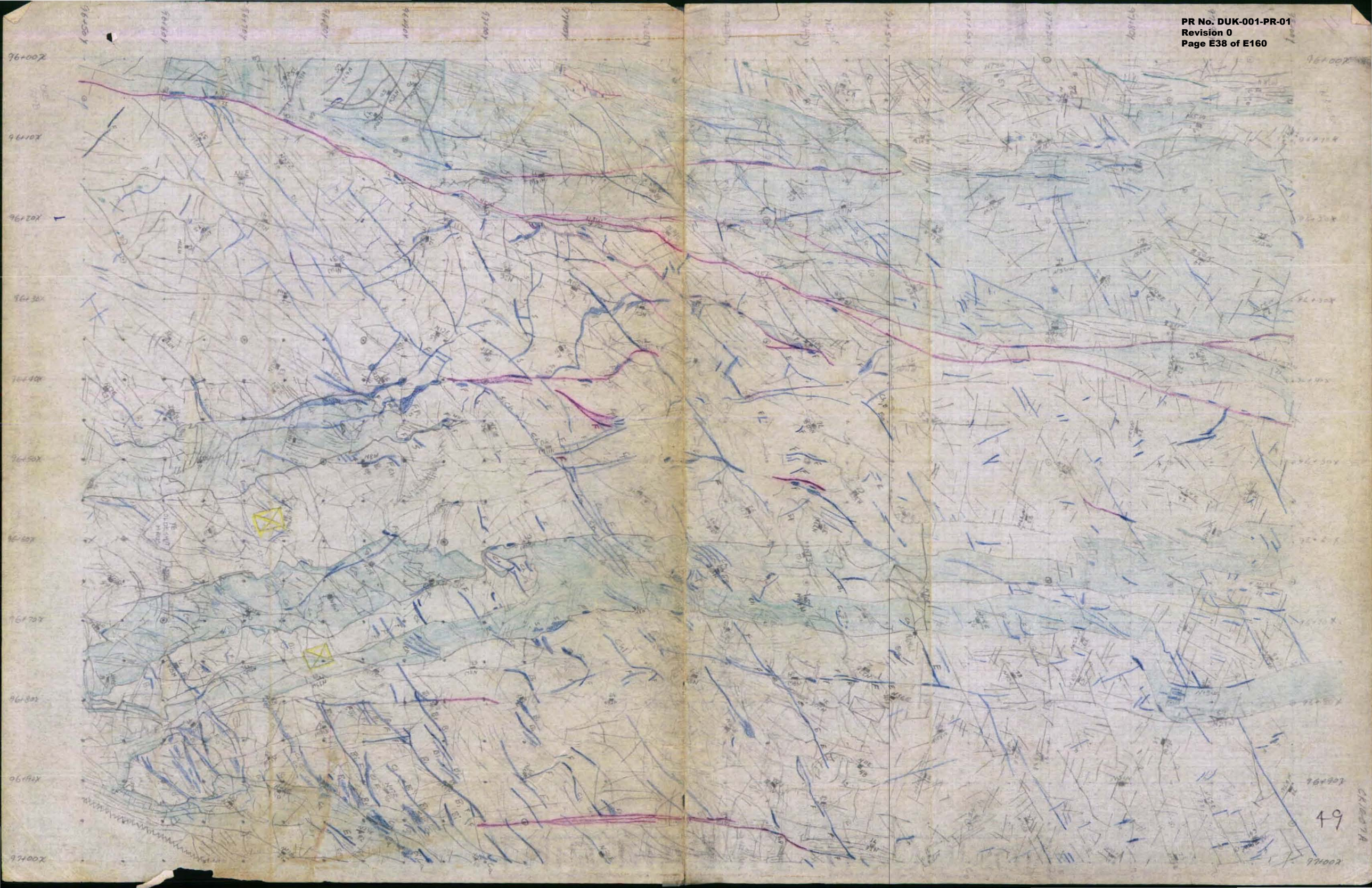

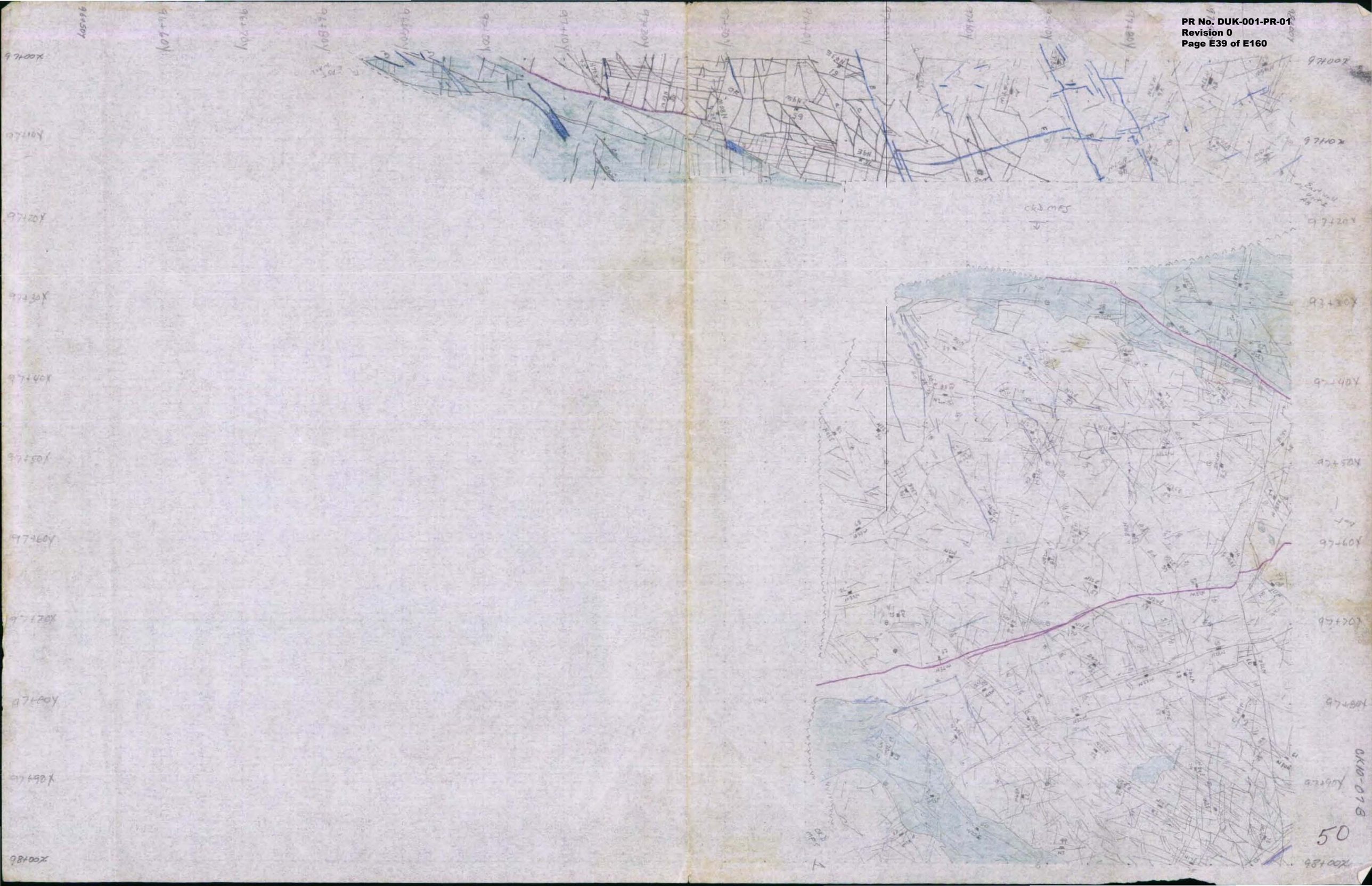
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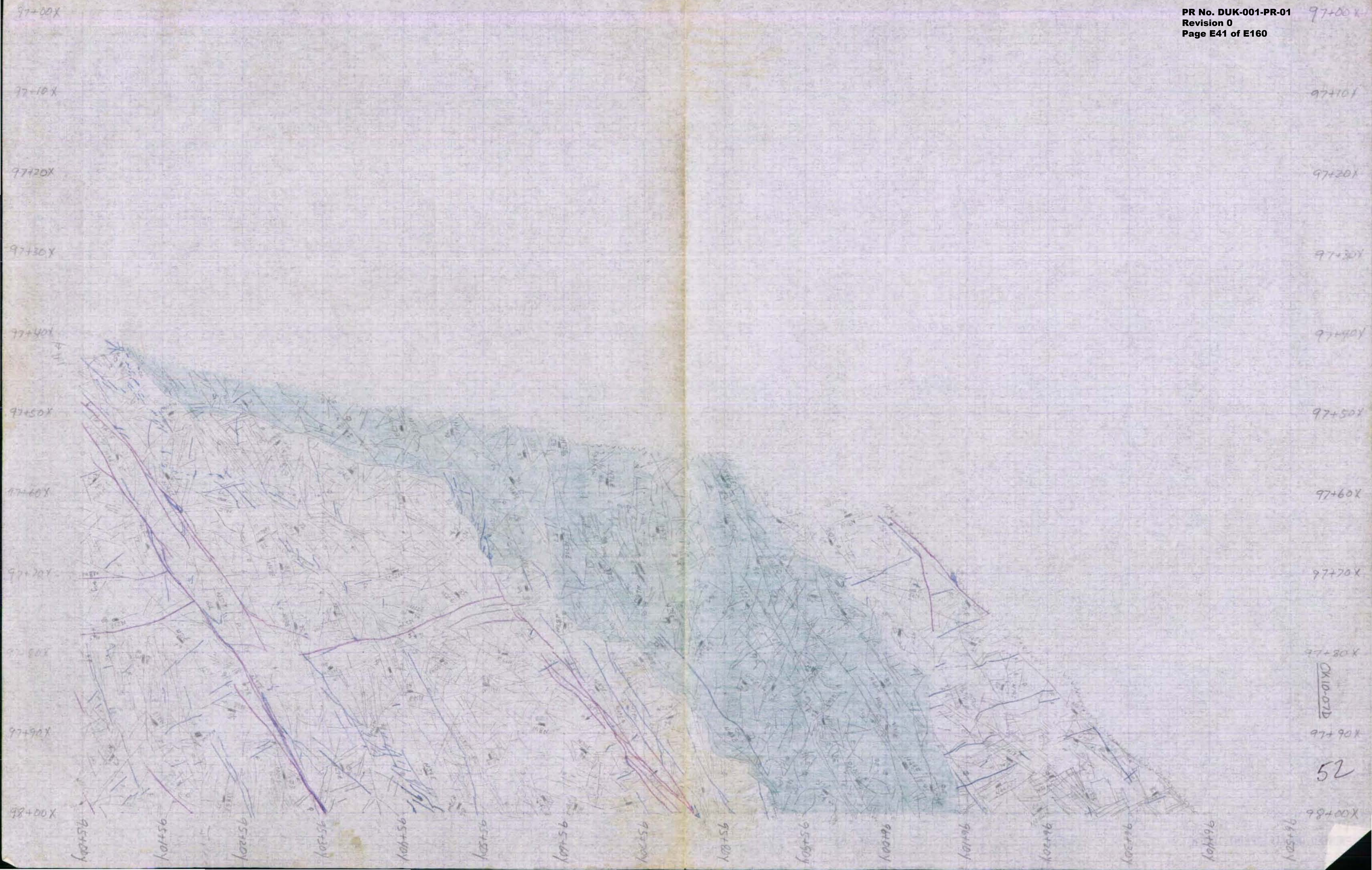
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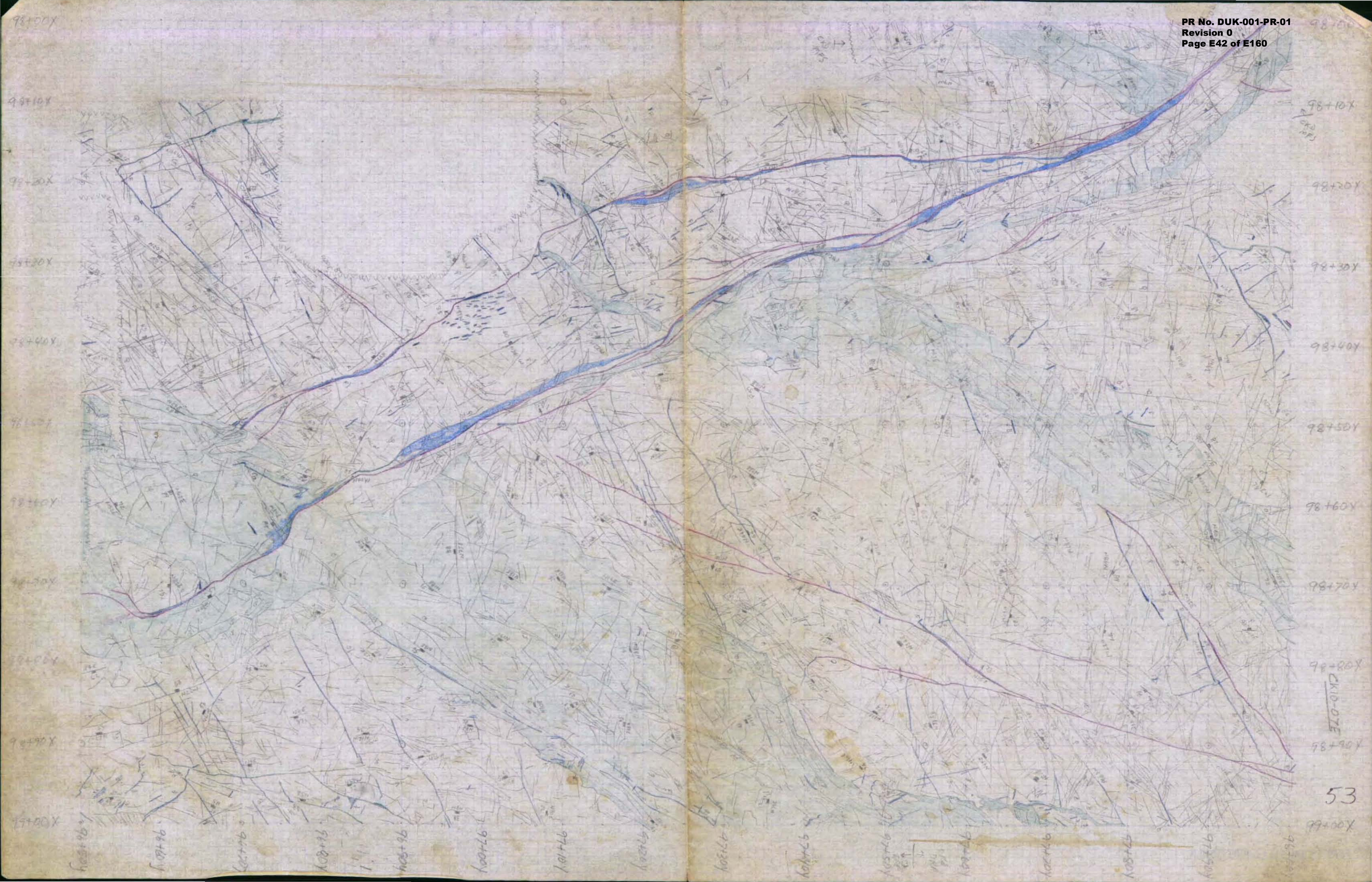
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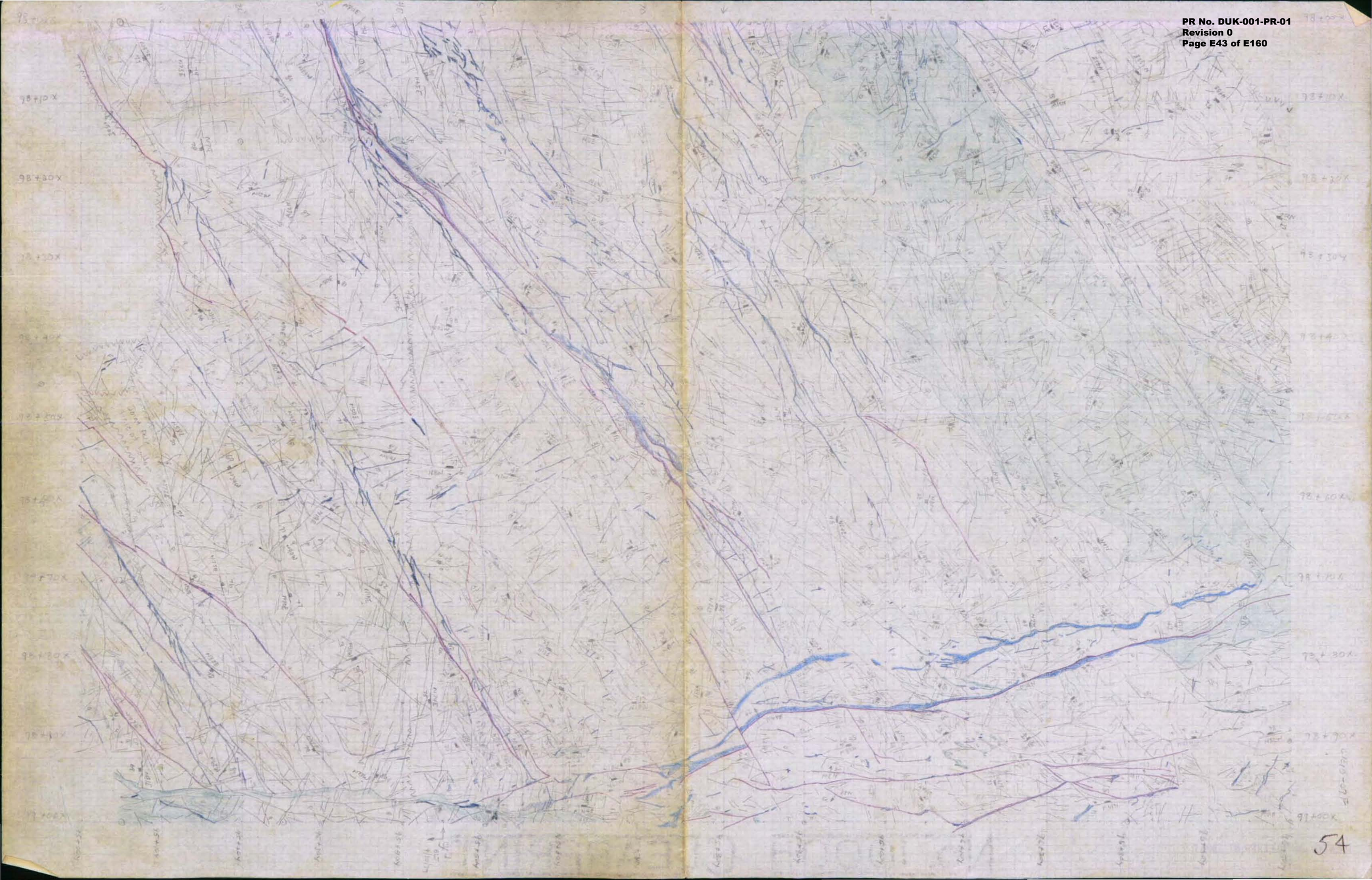

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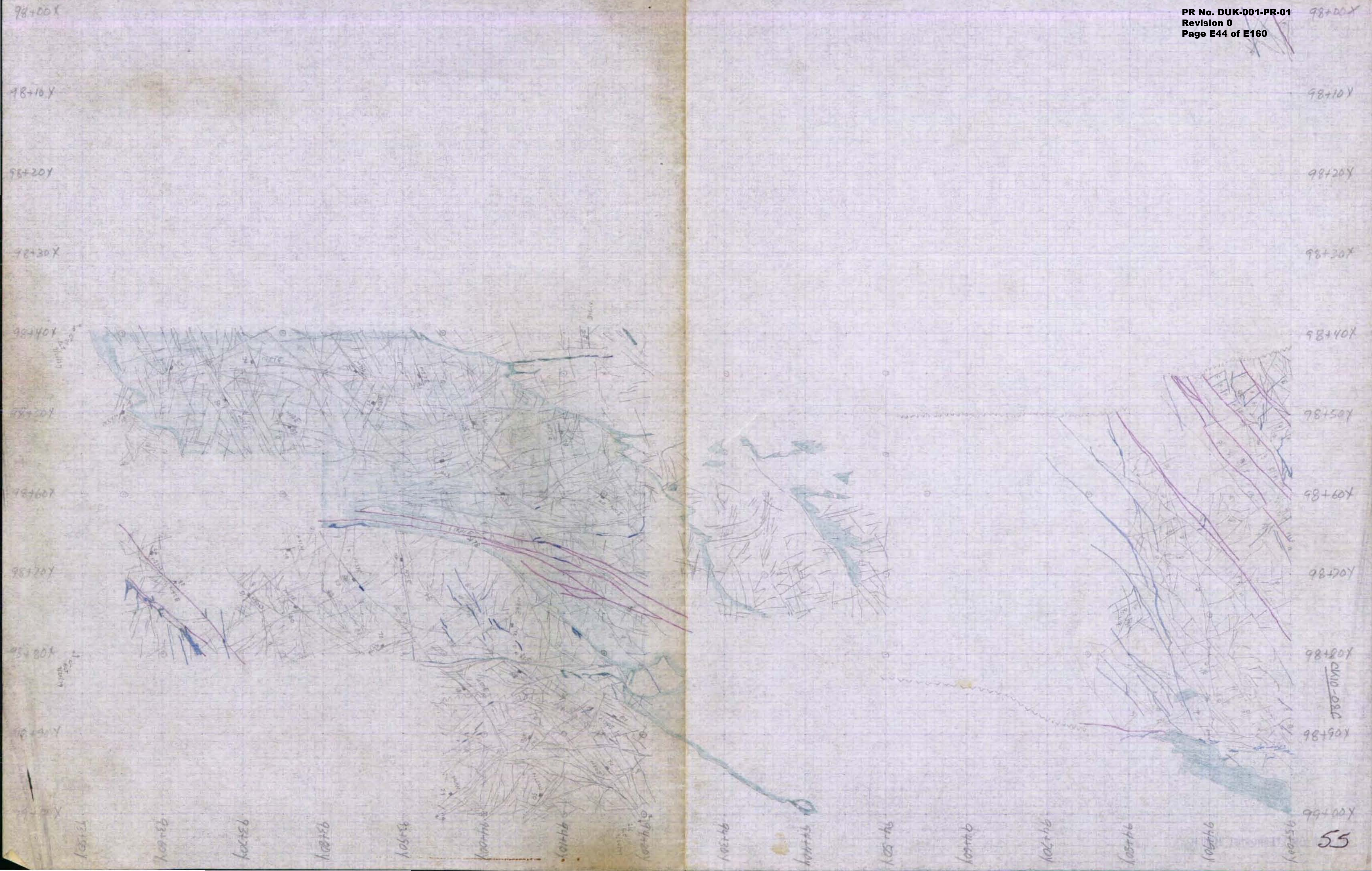
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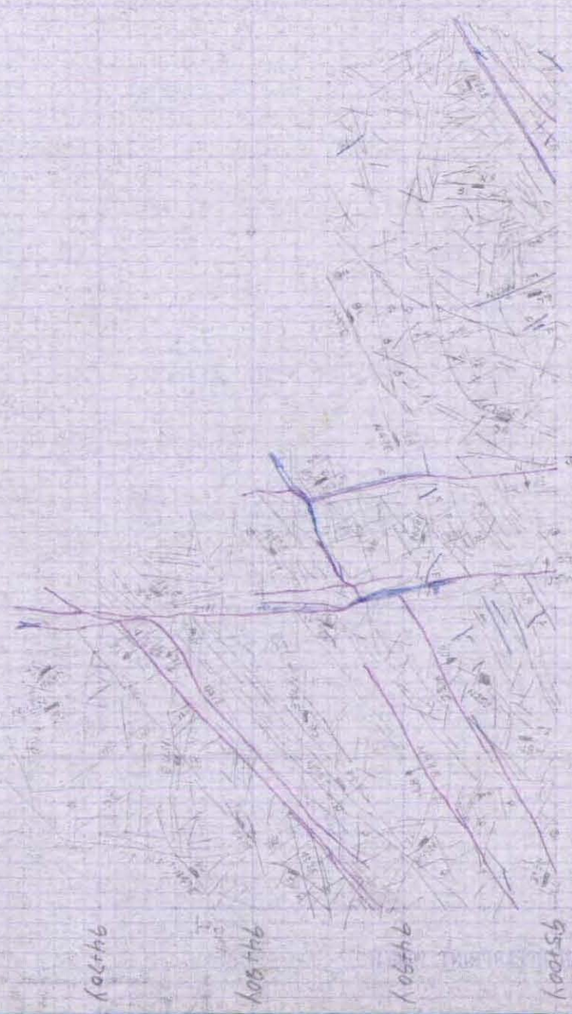

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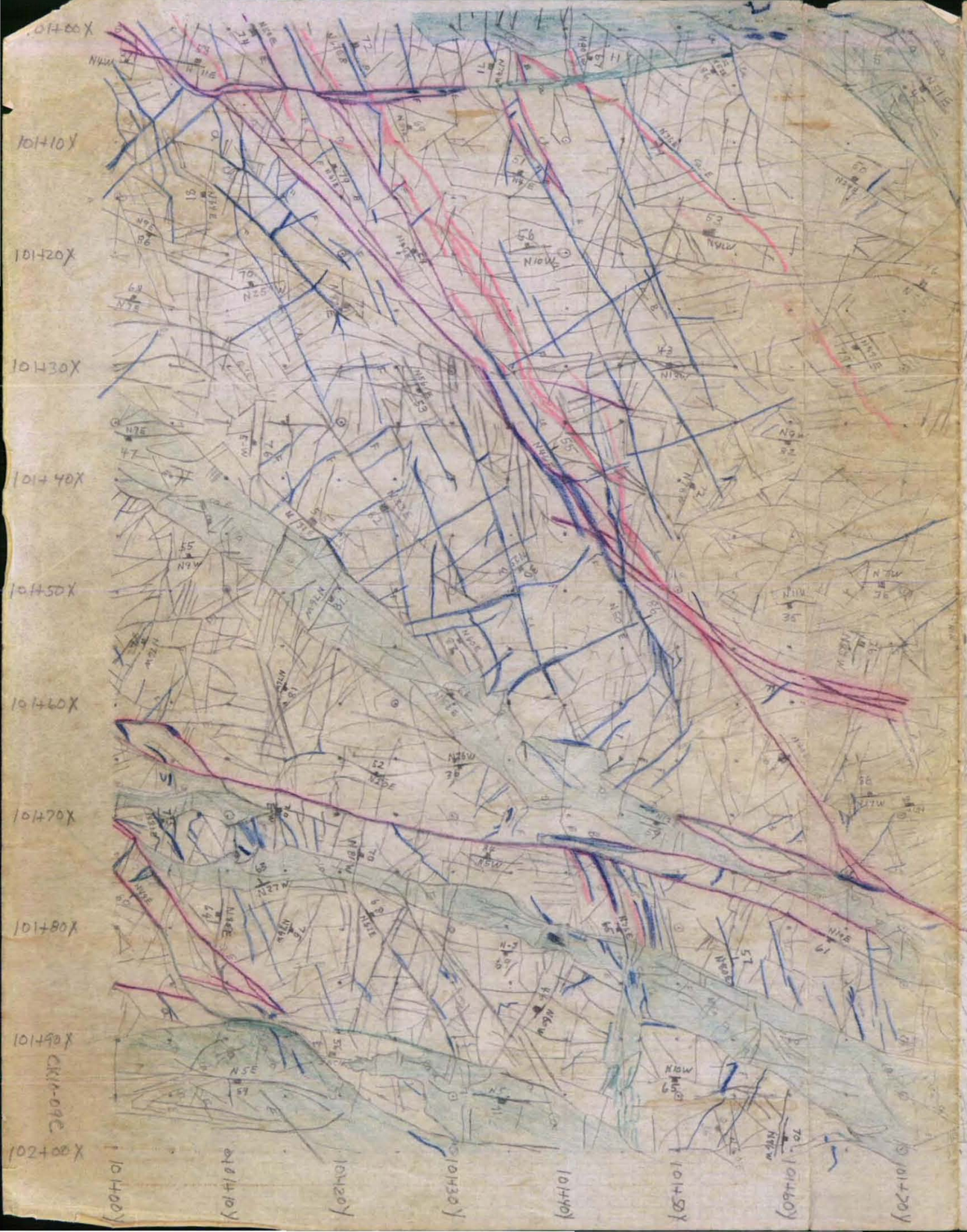
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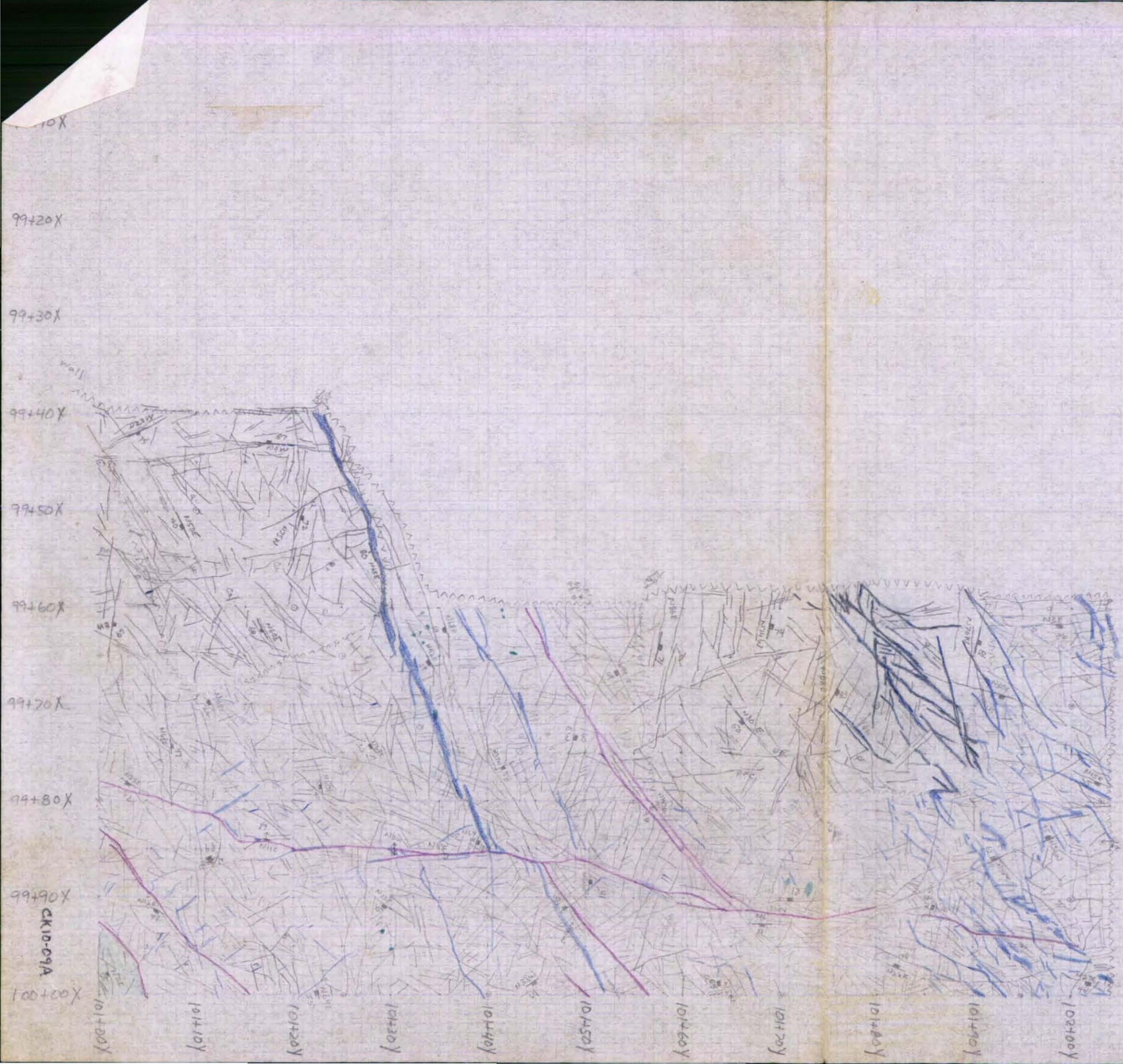
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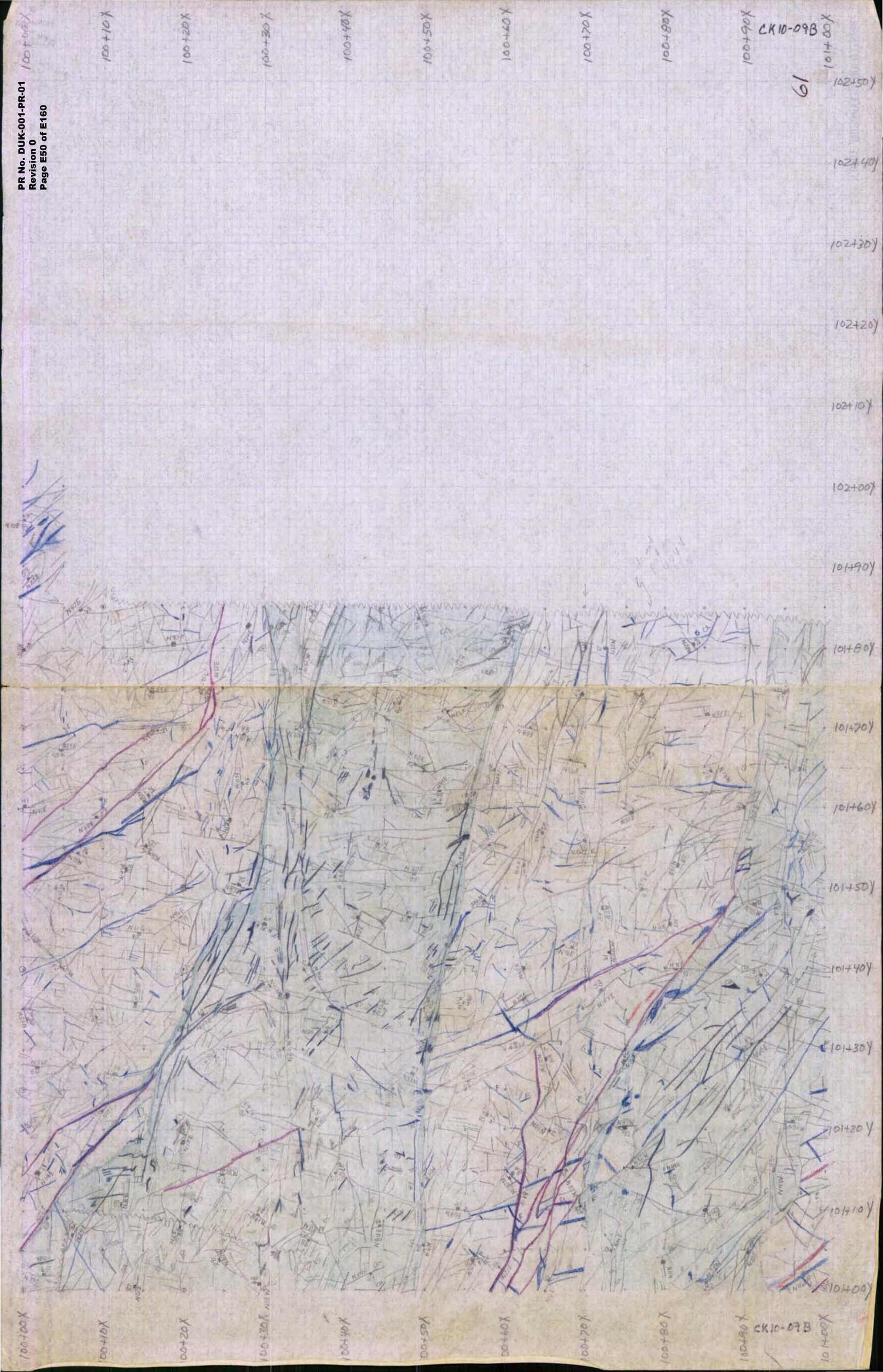
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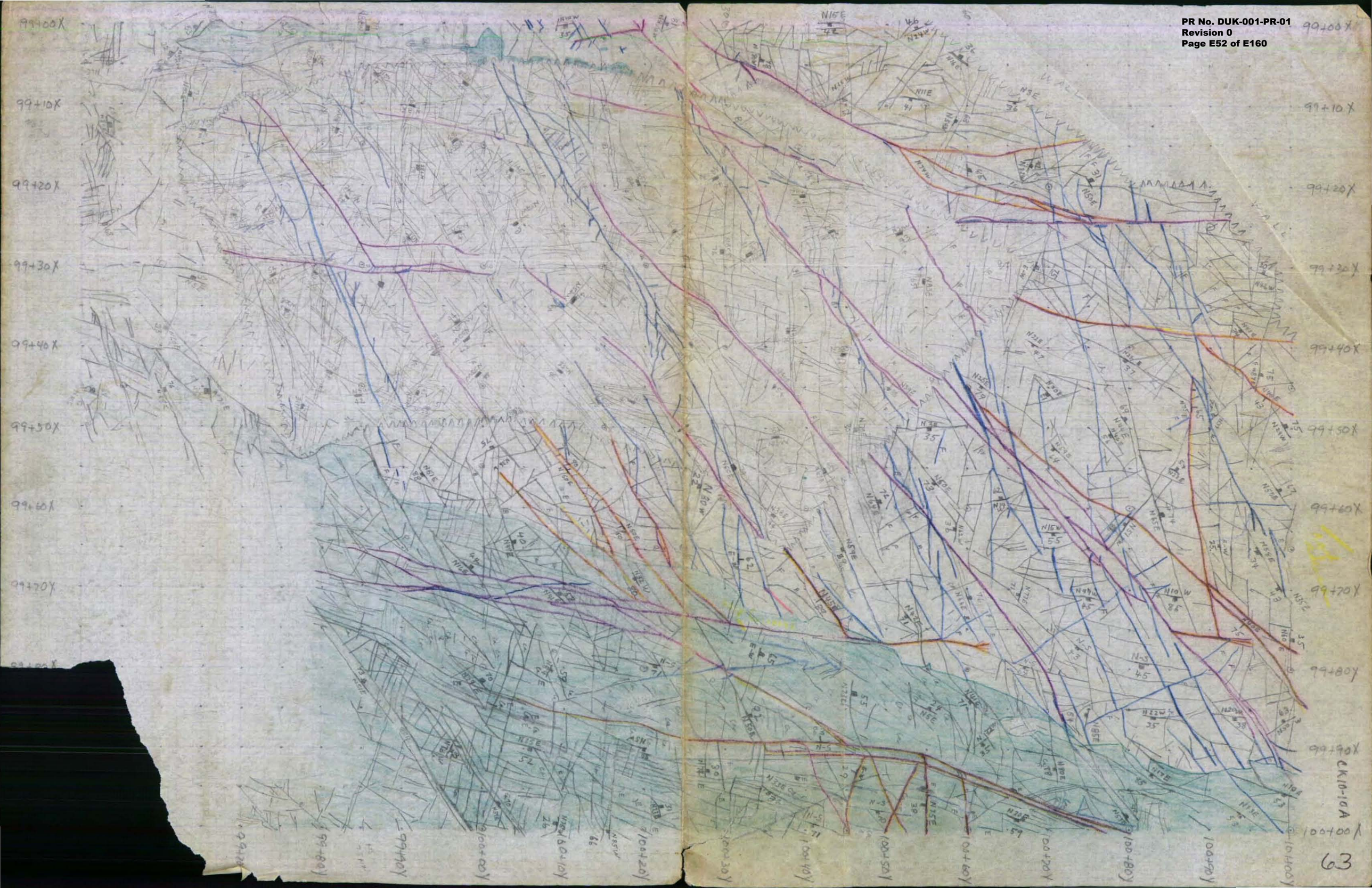
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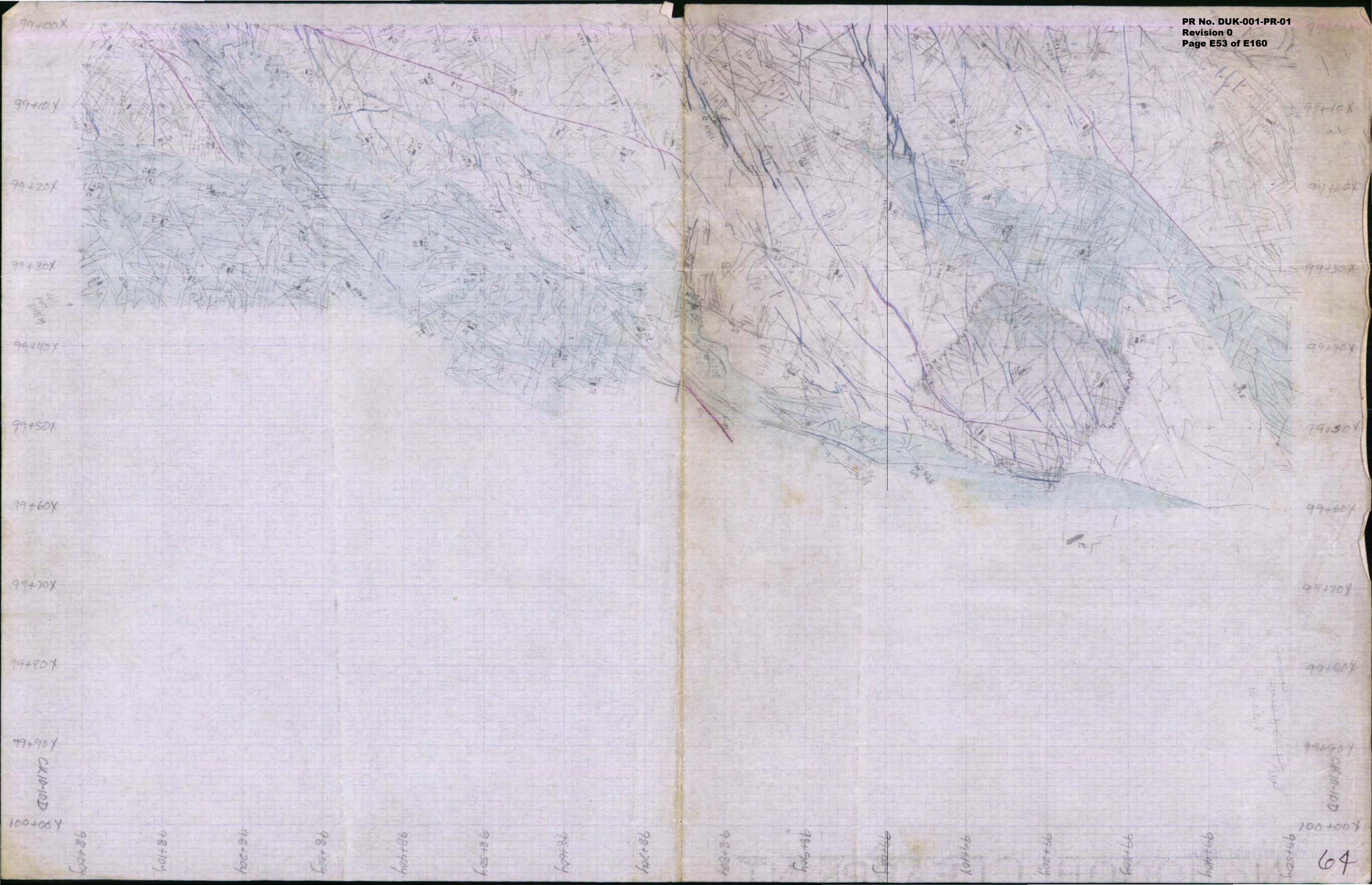
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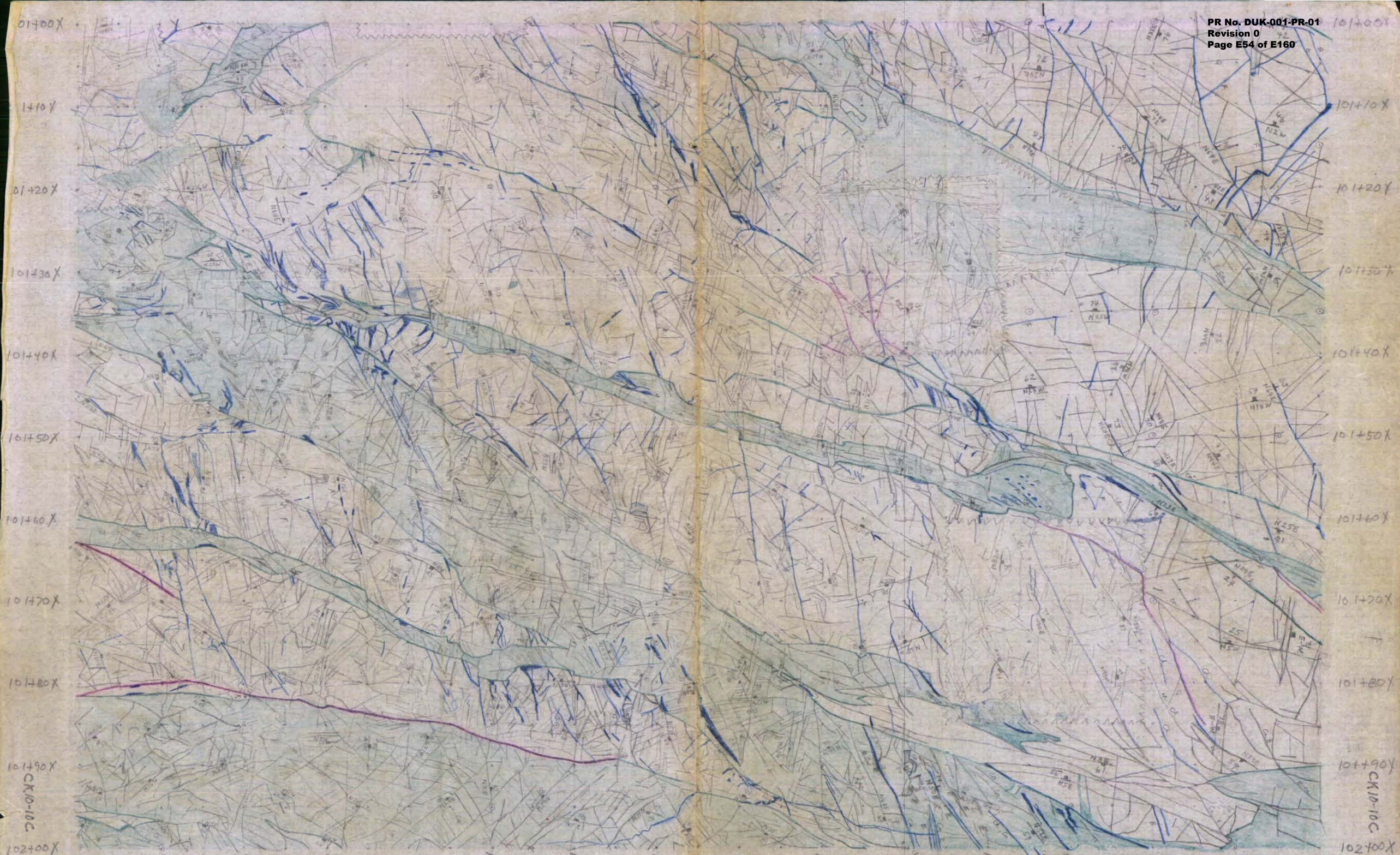
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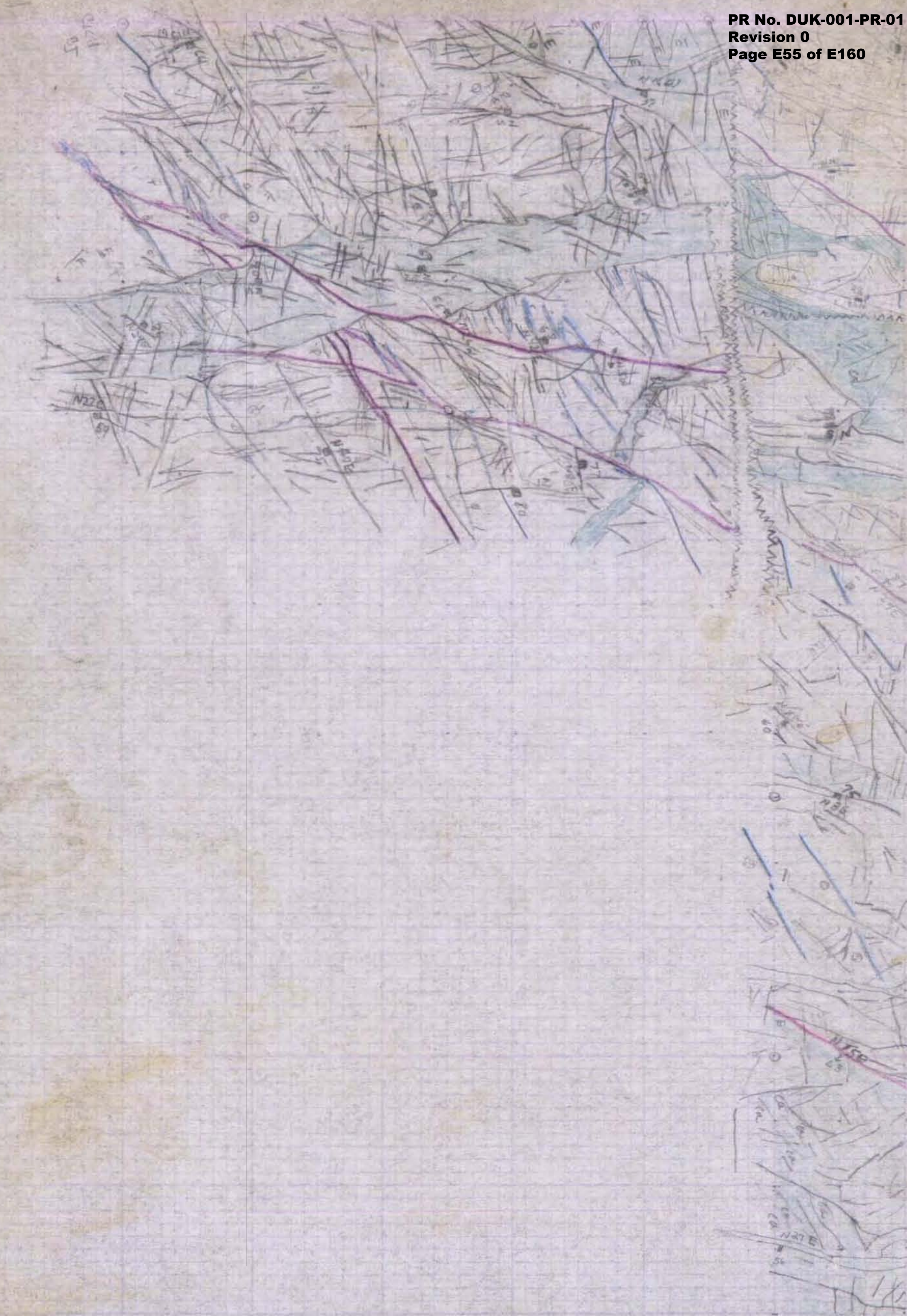


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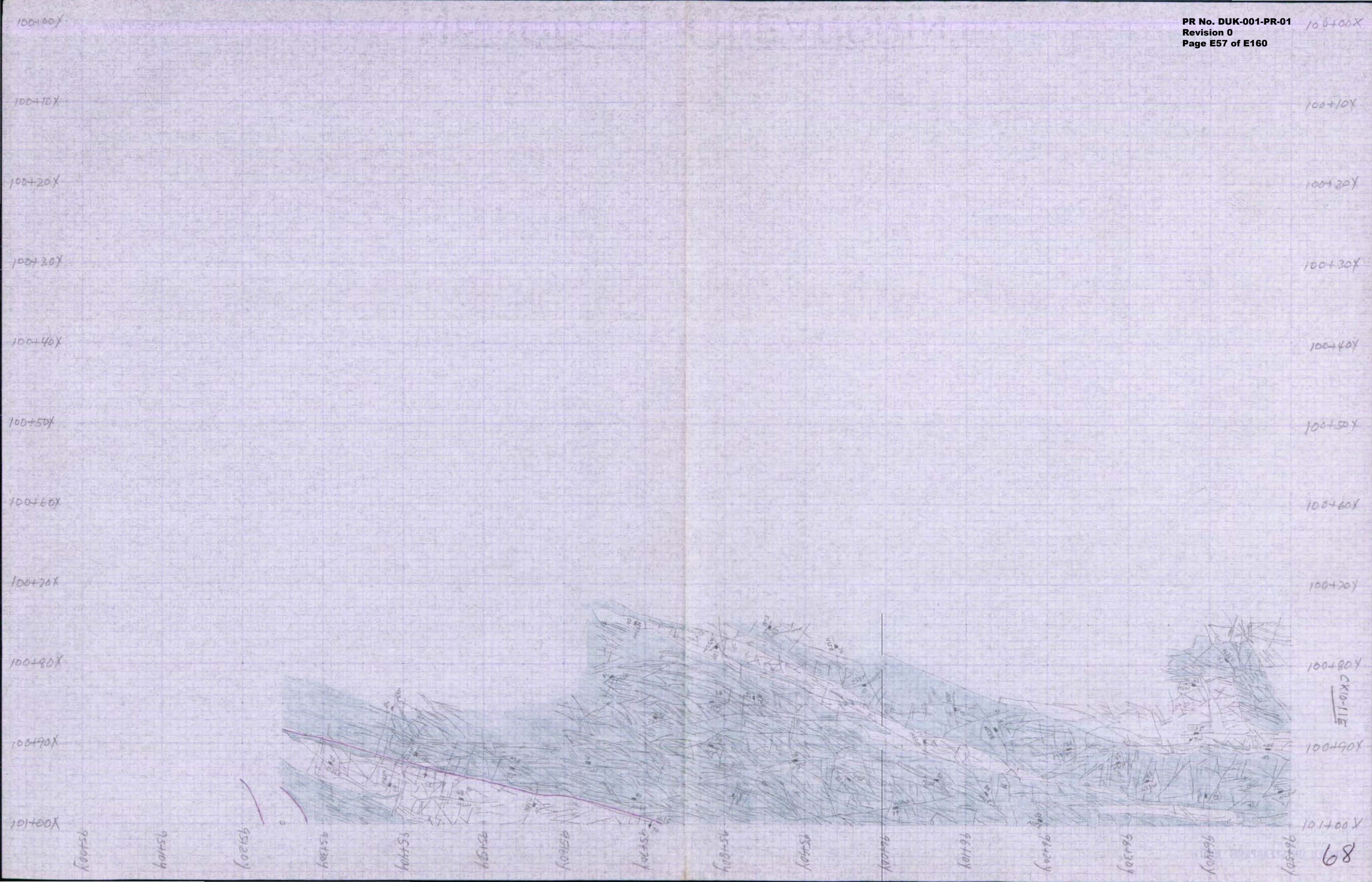
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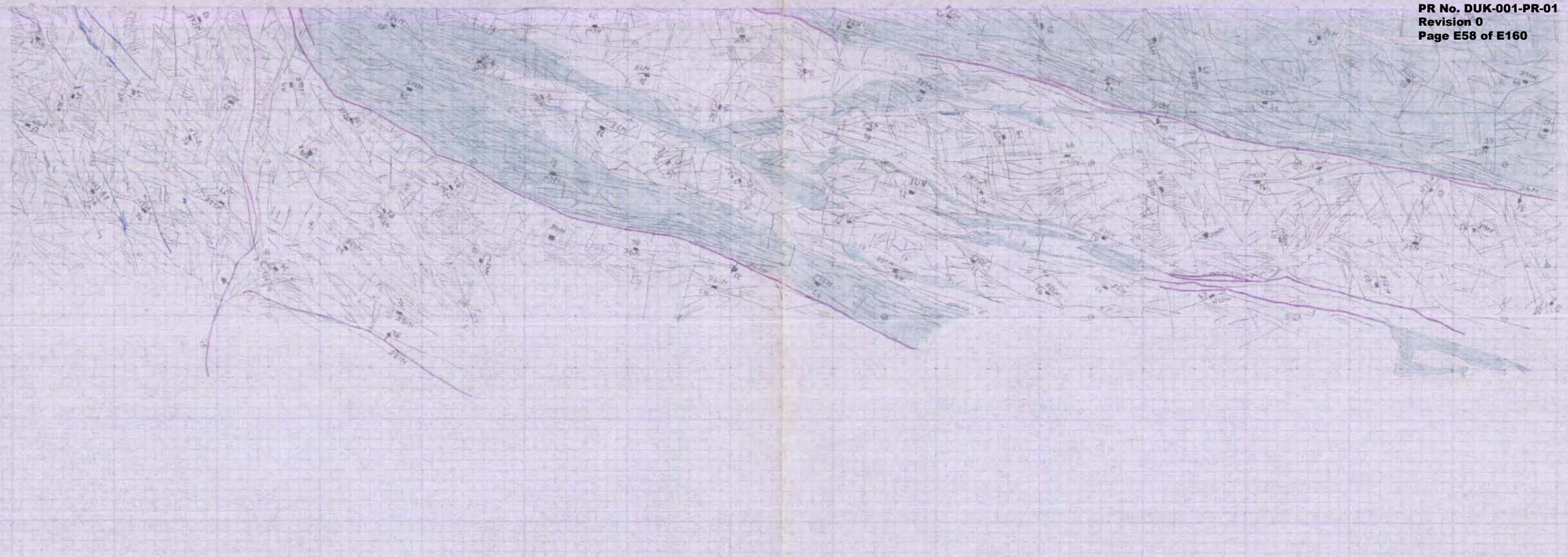
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CK10-11F

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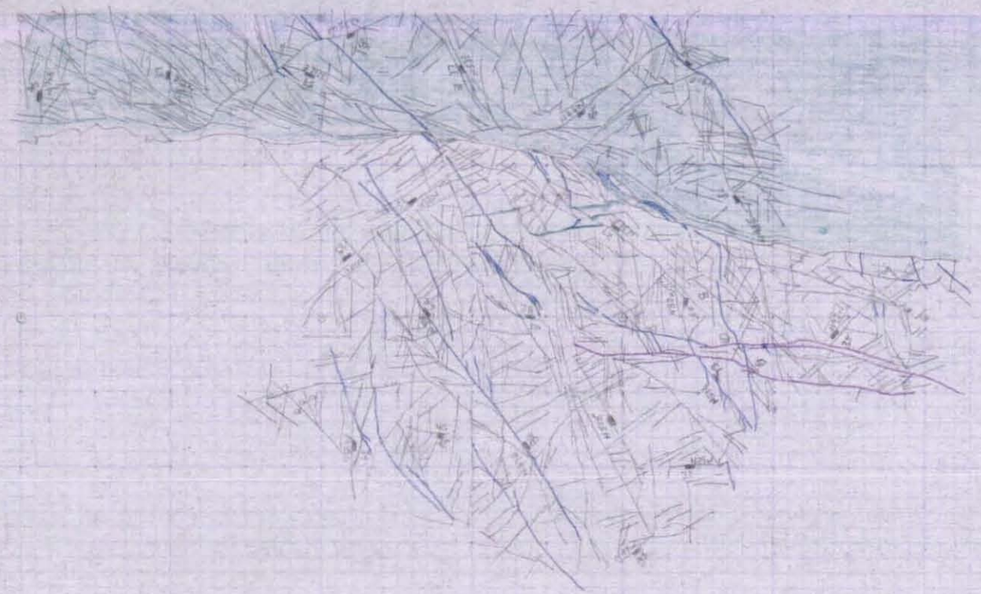

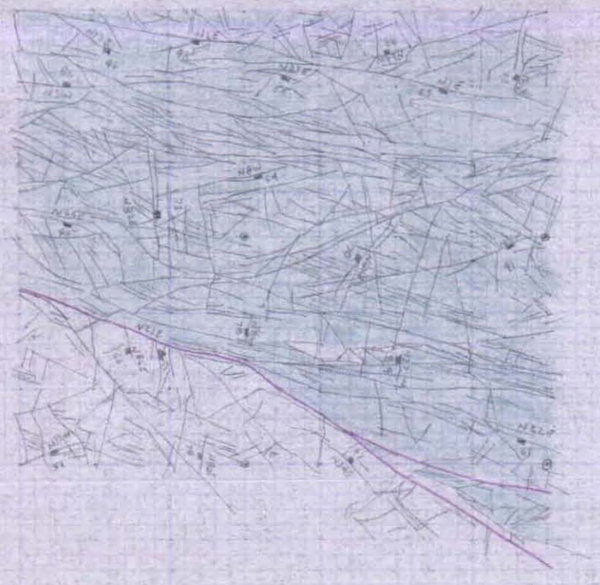

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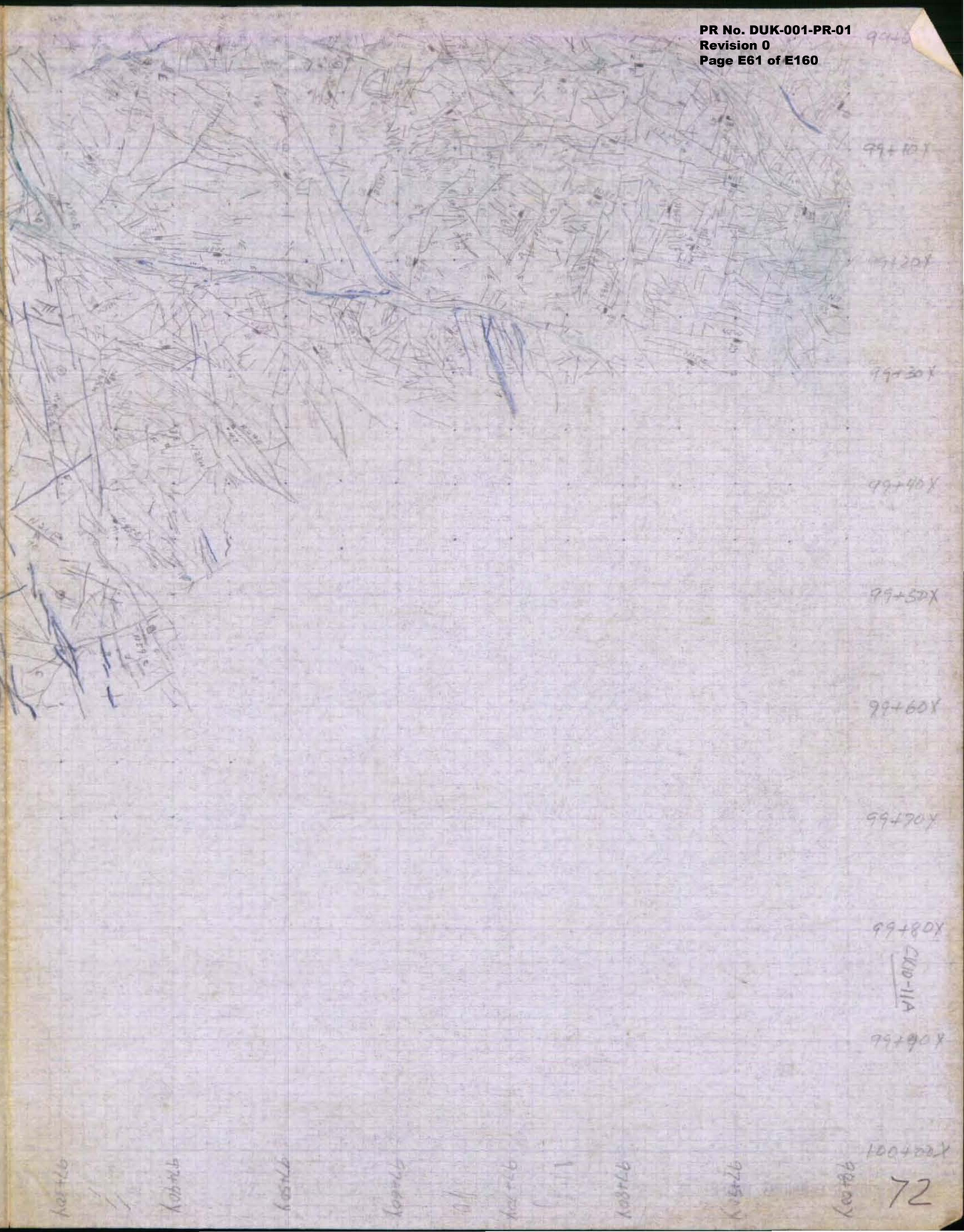

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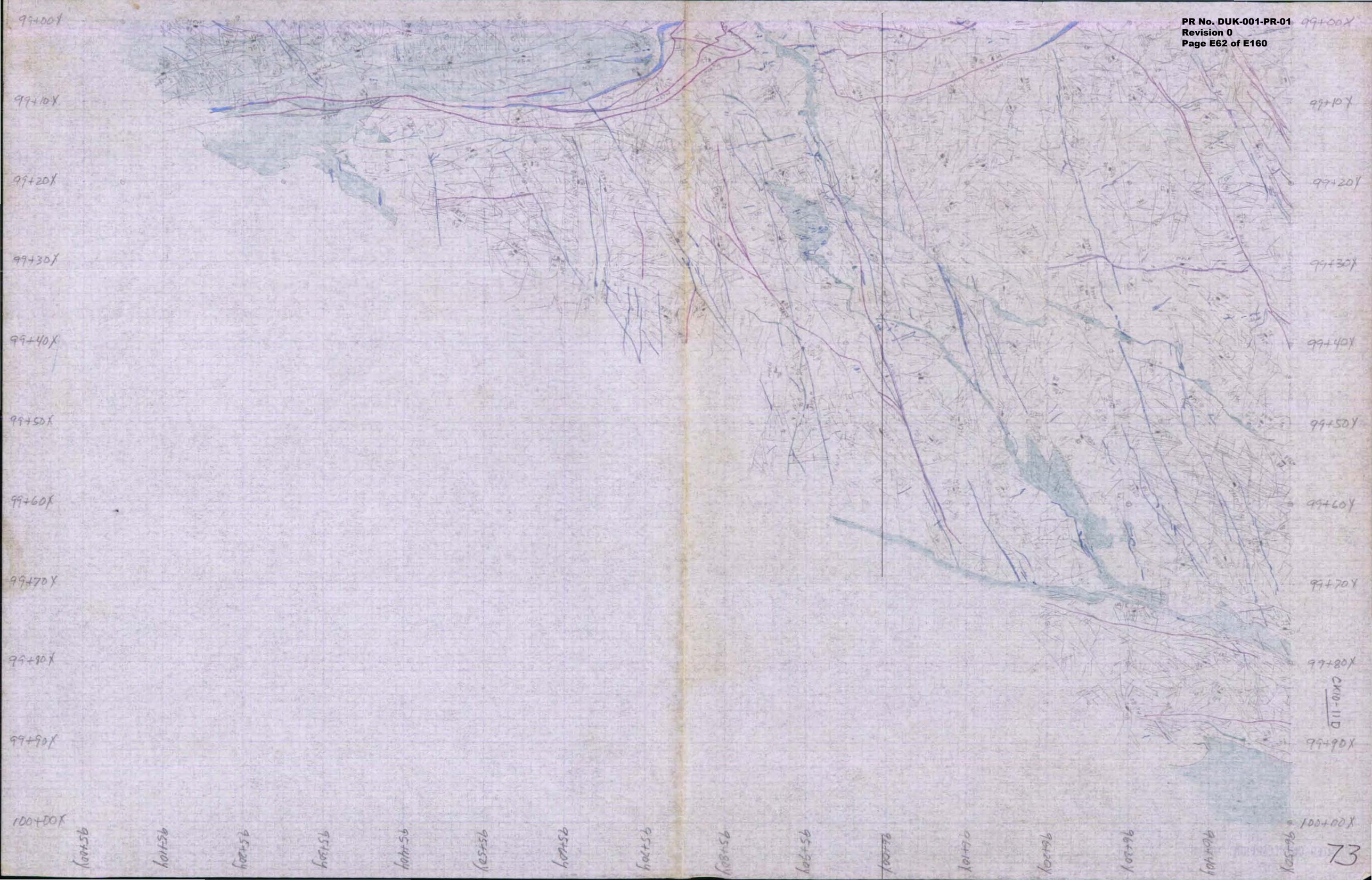
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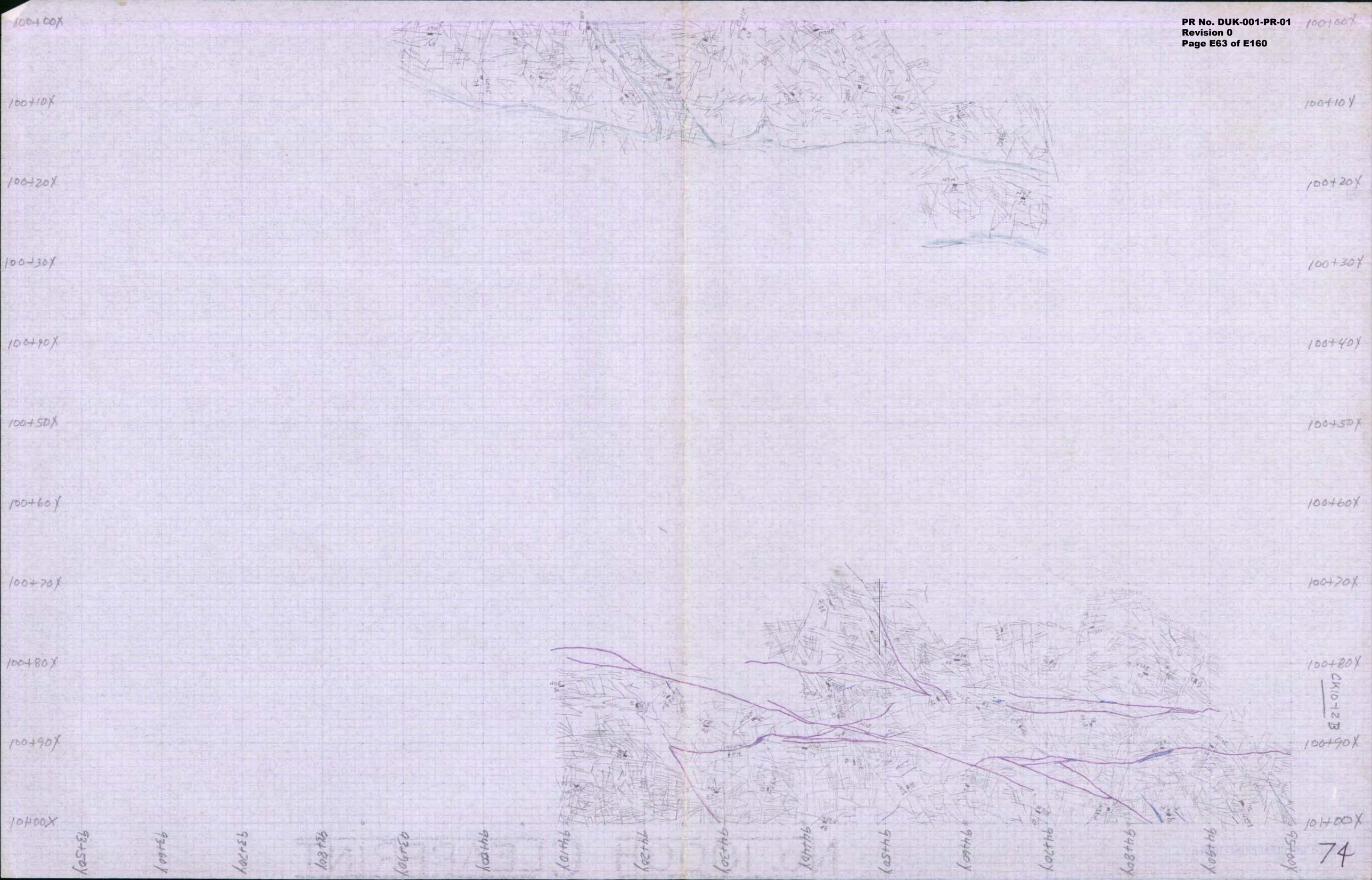
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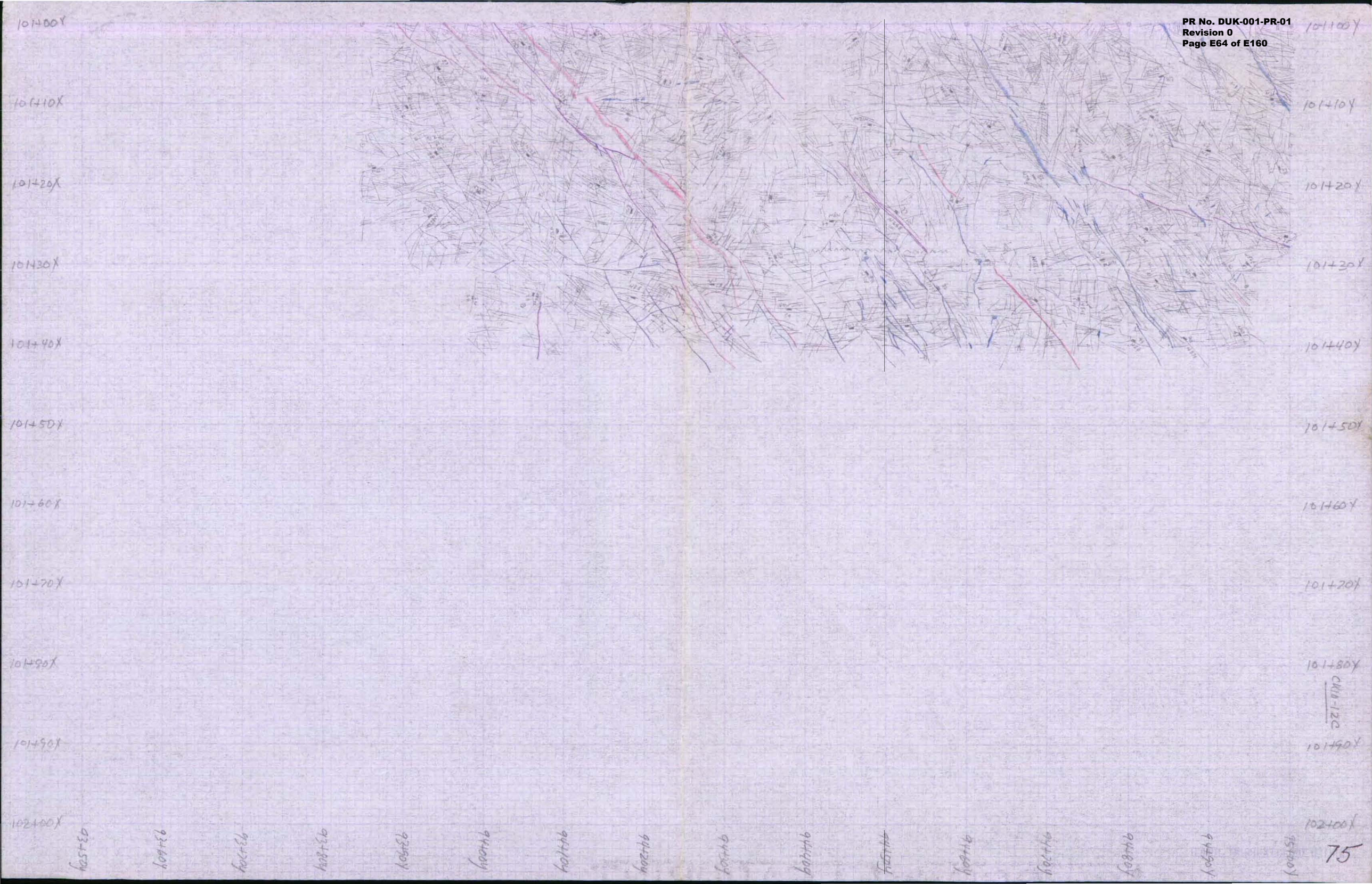
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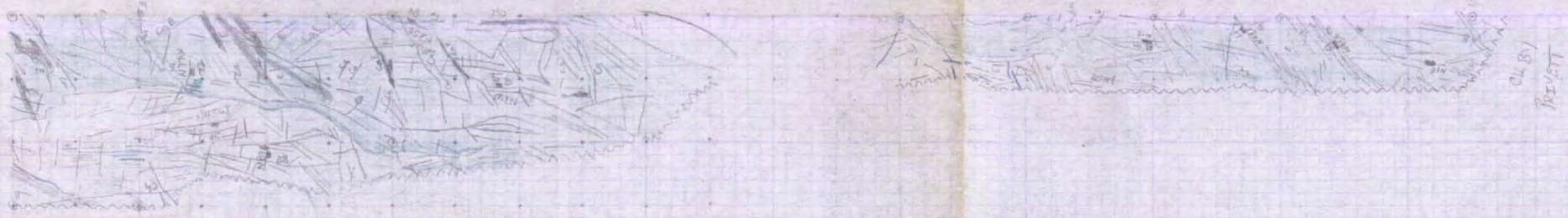
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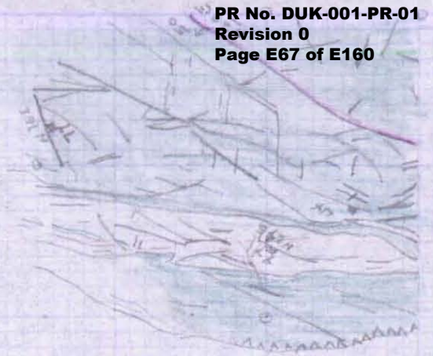

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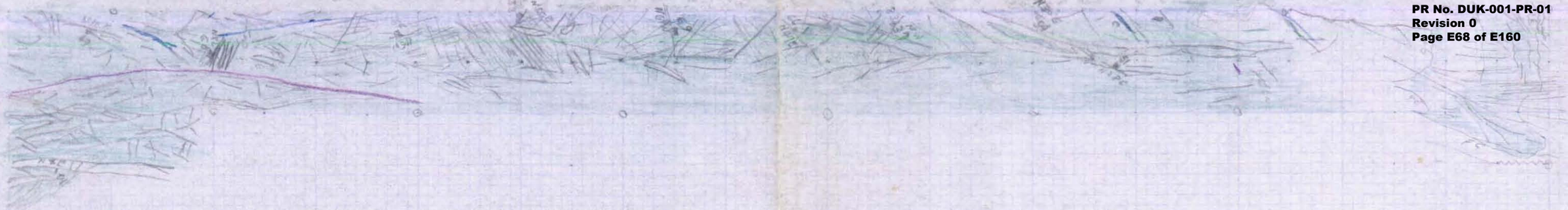
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Replacement Scans
(Transmitted June 4, 2010)

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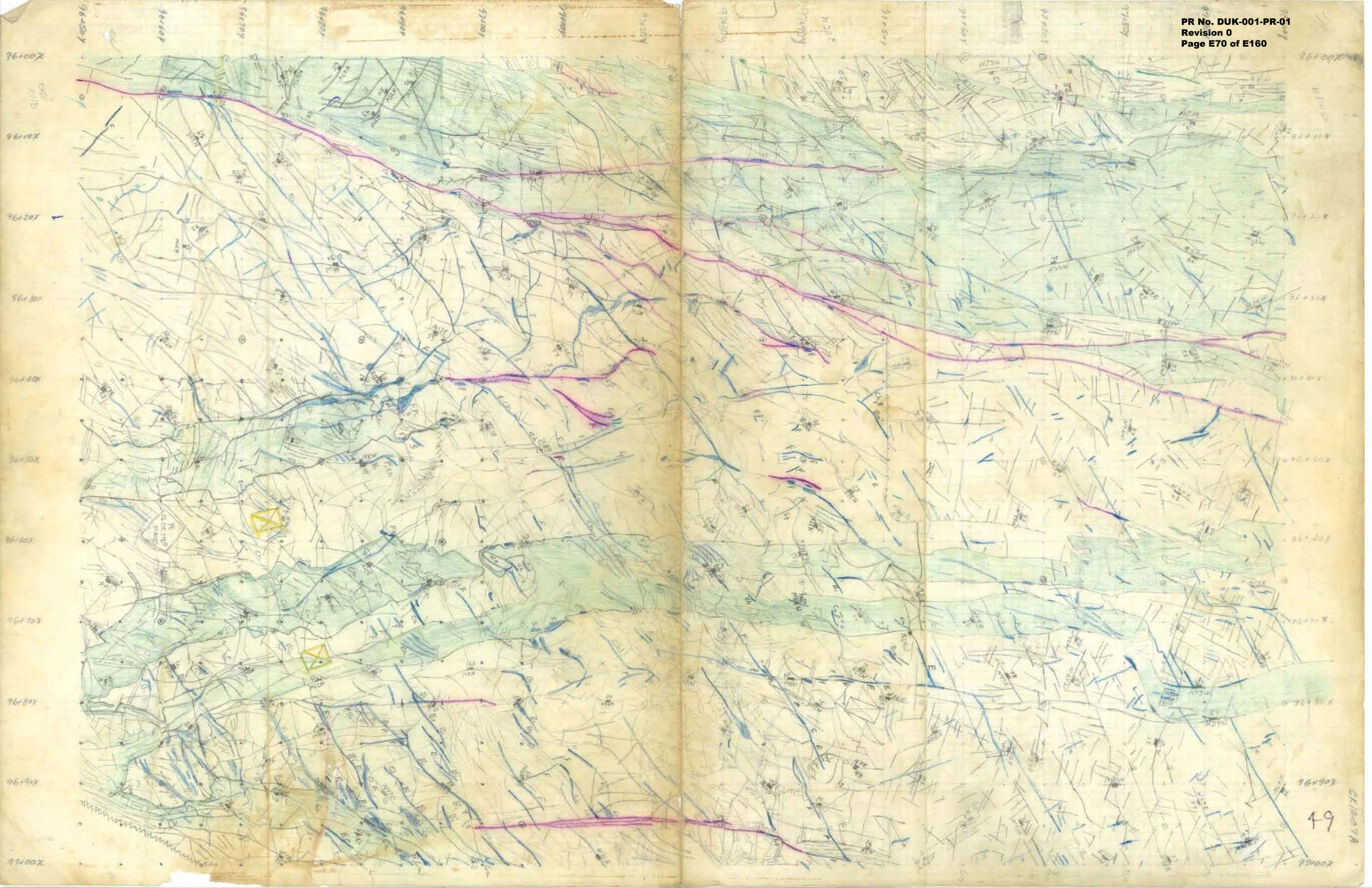
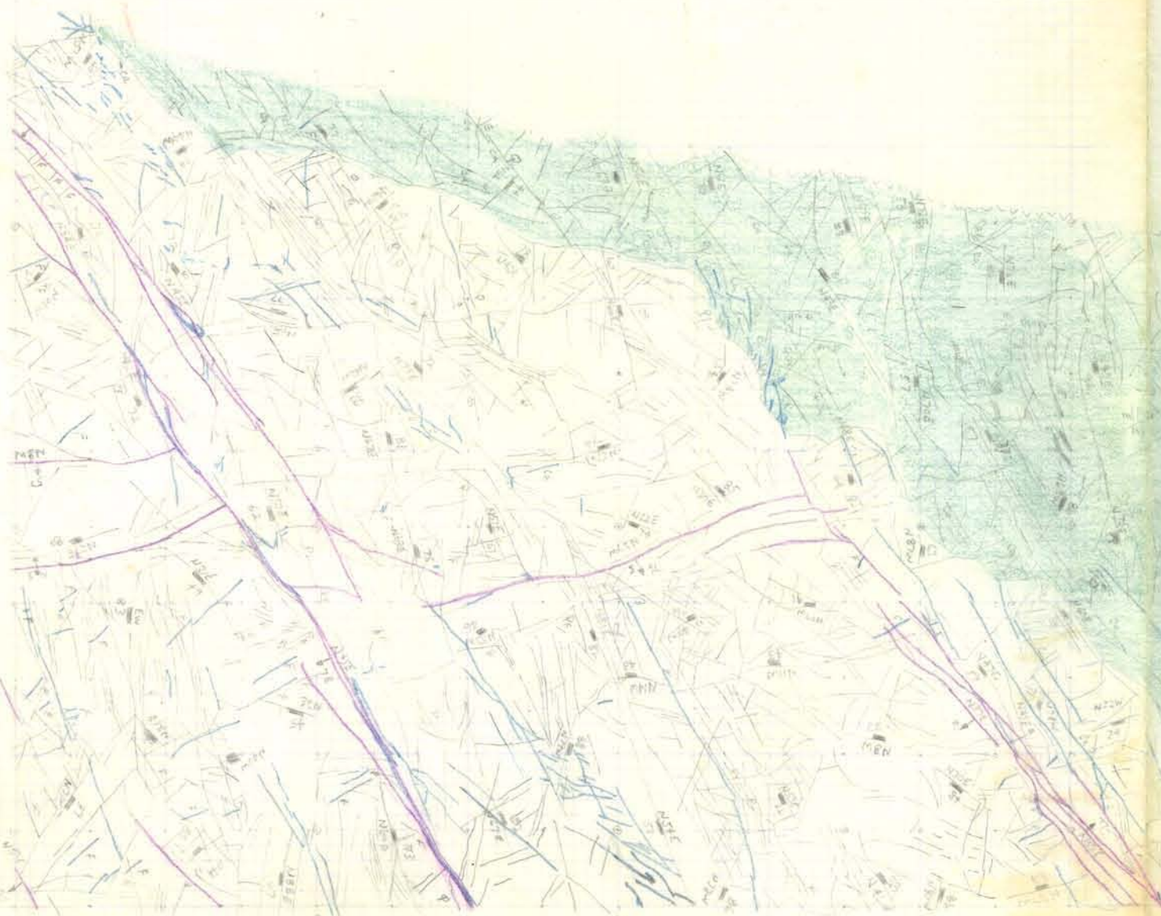
- 62 CK10-10B.JPEG
- 69 CK10-11F.JPEG
- 73 CK10-11D.JPEG

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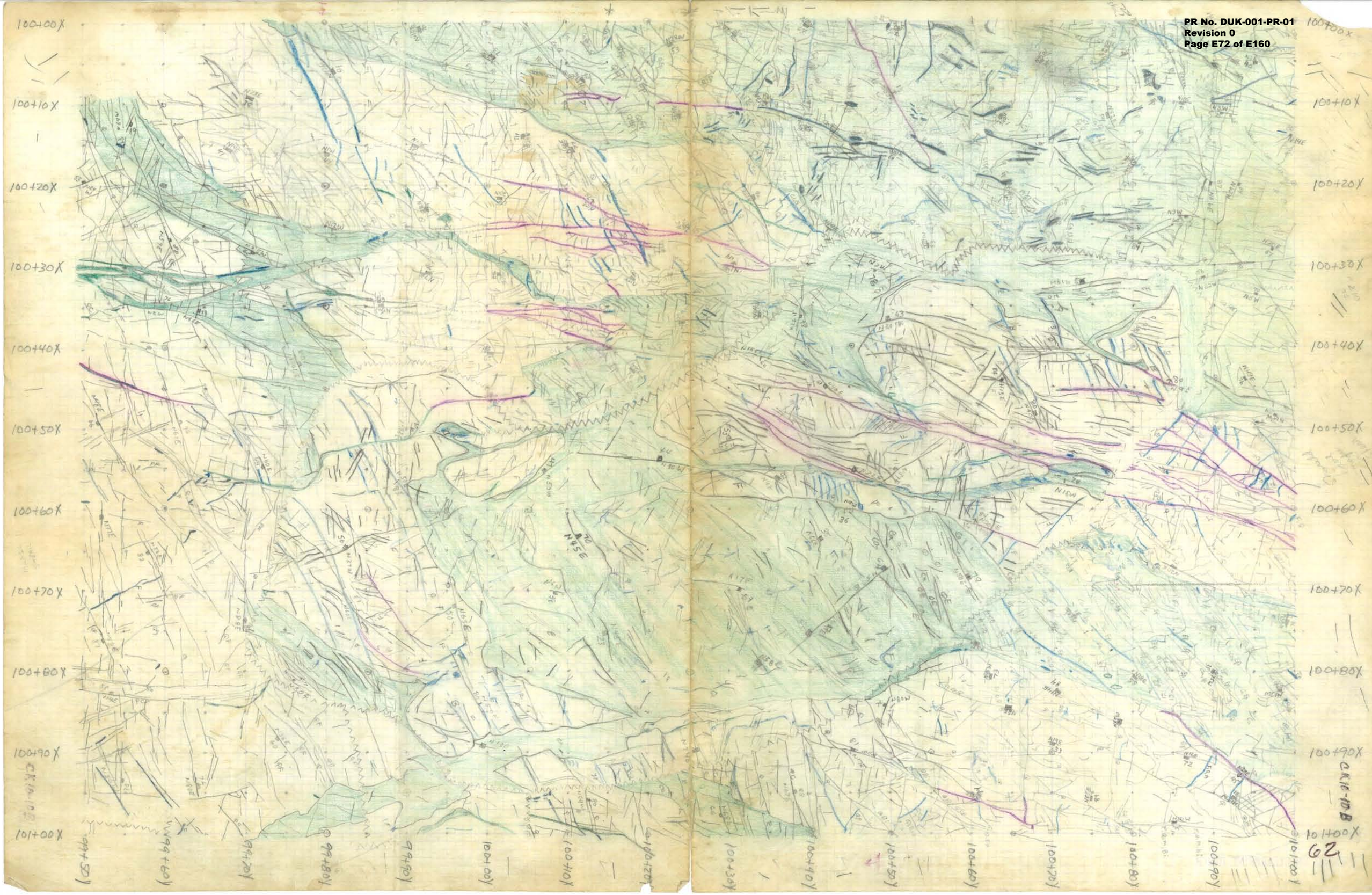
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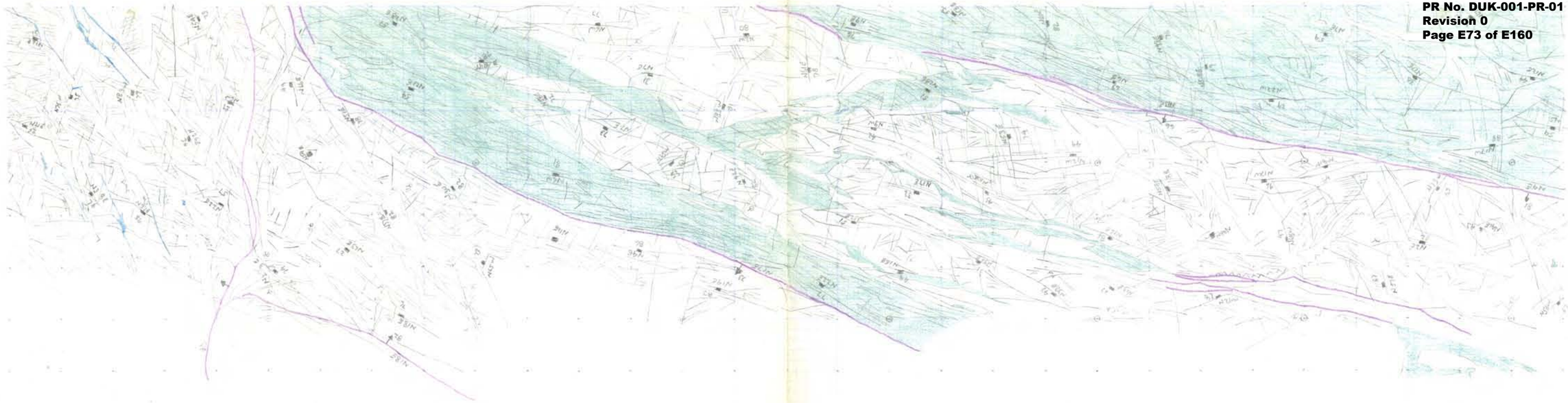
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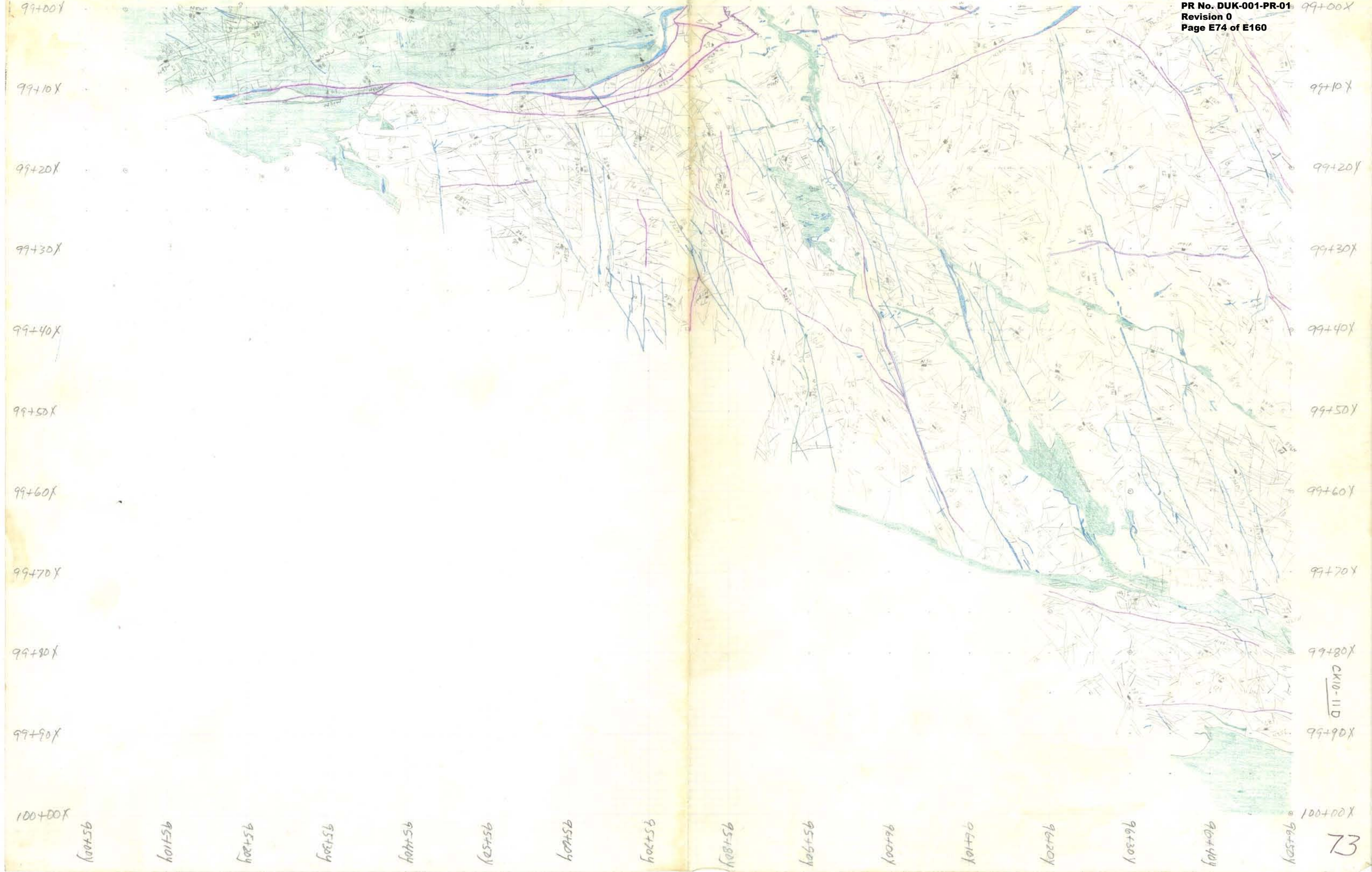
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ATTACHMENT 3

Record Transmittals:
Historical Mapping of the Excavation for Lee Nuclear Site
Historical Construction Photos of Unit 1 Area
Transmitted to FWLA from Duke Energy (March 23, 2007)

Updated Historical Foundation Mapping Documents
Transmitted to FWLA from Duke Energy (June 4,2010)

Final Foundation Index Map, Geologic Mapping Procedure, and Supplemental Mapping Guidance
Transmittal to FWLA from Duke Energy (November 23, 2010)

1780, 14.3

Duke Energy

DUK-010
DUKE LNS COL 1780

Mailing Address:
Mail Code EC05Z
526 South Church Street
Charlotte, NC 28201

704-382-4319

704-382-4545 fax

March 23, 2007

Mr. Robert Falk
ENERCON Services
12850 Middlebrook Rd
Suite 304
Germantown, MD 20874

Subject: Historical Mapping of the Excavation for Lee Nuclear Site
Historical Construction Photos of Unit 1 Area

MG 7/17/07

Dear Bob,

GM

G 5/27/07

Drawings showing the historical mapping of the excavation for Lee Nuclear Station listed below are being transmitted via three DVDs with this letter. Construction photos of the Unit 1 area listed below are also being transmitted via a CD-ROM.

Three DVDs Contain:
Folder CK 10-01 (Drwgs 20, 21)
Folder CK 10-02 (Drwgs 22,23,24,25,26,27,28)
Folder CK 10-03 (Drwgs 29,30,31,32,33,34)
Folder CK 10-04 (Drwgs 35,36,37,38)
Folder CK 10-05 (Drwgs 39,40,41)
Folder CK 10-06 (Drwgs 42,43,44,45,46,47)
Folder CK 10-07 (Drwgs 48,49,50,51,52,53,54)
Folder CK 10-08 (Drwgs 55,56,57,58)
Folder CK 10-09 (Drwgs 59,60,61)
Folder CK 10-10 (Drwgs 62,63,64,65,66,67)
Folder CK 10-11 (Drwgs 68,69,70,71,72,73)
Folder CK 10-12 (Drwgs 74,75,76)
Folder CK 10-13 (Drwg 77)
Folder CK 10-14 (Drwgs 78,79)

CD 26

CD 27

CD 28

CD-ROM Contains:
Construction Photos
No. 436,467,476,485,501,503,504,518,530,544,557,641,653,670, 792,832,833,922,1012,1359,1360

CD 25

If you have any questions, please call me at 704-382-4319.

Sincerely,

Dale M Smith
Civil Engineering Lead

Enclosures: Three DVDs
CD-ROM

Cc: Mike Gray, Lettis (with enclosure)
R. L. Morgan, Jr. (without enclosure)
J. S. Thrasher (without enclosure)
4000.01-09 (without enclosure)

Duke Energy
EC09D/ 526 South Church Street
Charlotte, NC 28201-1006

Mailing Address:
P.O. Box 1006 – EC09D
Charlotte, NC 28201-1006

704-382-7830

704-382-2038 fax

Jun. 4, 2010

Mr. Tom Slavonic
Enercon Services
4490 Old William Penn Highway
Murrysville, PA 15668

Subject: Updated Historical Foundation Mapping Documents

Dear Tom:

The attached CD contains updated scans of five historical field documents that were problematic for the foundation mapping work being performed by FWLA. This information supplements and replaces that transmitted by Duke Energy's letter of March 23, 2007 (Dale Smith to Bob Falk) for these five map panels. The five files are identified as shown below.

CD#29

Map Panel Designation	Former File Name	New File Name	File Properties
CK10-07A	49.tif	49 CK10-07A.jpg	Created 6/3/2010 5:32 pm; Size 10,108,309 bytes
CK10-07D	52.tif	52 CK10-07D.jpg	Created 6/3/2010 5:33 pm; Size 7,049,104 bytes
CK10-10B	62.tif	62 CK10-10B.jpg	Created 6/3/2010 5:34 pm; Size 10,205,854 bytes
CK10-11F	69.tif	69 CK10-11F.jpg	Created 6/3/2010 5:35 pm; Size 4,143,323 bytes
CK10-11D	73.tif	73 CK10-11D.jpg	Created 6/3/2010 5:36 pm; Size 6,244,638 bytes

If you have questions, please call me at 704-382-7830.

Sincerely,

John M. McConaghy, Jr.
Engineering Consultant

Enclosure: 1 CD as described

cc: Mike Gray, FWLA (w/ enclosure)
R.L. Morgan (w/o enclosure)
J.S. Thrasher (w/o enclosure)
J.R. Cassidy (w/o enclosure)
4000.01-09 (w/ enclosure)

Duke Energy
EC09D/ 526 South Church Street
Charlotte, NC 28201-1006

Mailing Address:
P.O. Box 1006 – EC09D
Charlotte, NC 28201-1006

704-382-7830

704-382-2038 fax

November 23, 2010

Mr. Tom Slavonic
Enercon Services
4490 Old William Penn Highway
Murrysville, PA 15668

Subject: Final Foundation Index Map, Geologic Mapping Procedure, and Supplemental Mapping Guidance

Dear Tom:

After our recent teleconference on qualification of Cherokee legacy geologic mapping documentation, Adam Wade pointed out that FWLA still needed to receive controlled distribution of several documents, including the Final Foundation Index Map, and the geologic mapping procedures, as well as input on those procedures from Dr. Hatcher. The attached CD contains these documents, as retrieved from several sources.

The files whose file name includes a Duke microfilm reel number were obtained from scans of microfilm records from Duke archives, and can be identified by the reel and frame number stenciled at the left of each page. The document whose name contains “MFS CK1108.00” was retrieved from Malcolm Schaeffer’s Cherokee correspondence files that are now maintained as part of the Lee project documentation. The documents containing “LETCo” in the filename were retrieved from the Law Engineering Cherokee files at MACTEC.

Comparison of the Duke and Law versions of the Geologic Mapping procedure give high confidence that the content of the two is the same, and reflects the procedures used in the field.

The Duke archive microfilm record contains only the first page of Dr. Hatcher’s letter, but it is the same as the first page of Mr. Schaeffer’s complete (two-page) document. Comparing Mr. Schaeffer’s CK1108.00 complete Hatcher document to the comparable document from Law, one can confirm that the content is the same.

The CK1108.00 version and the Law version of the Hatcher letter differ in some cosmetic ways such as pagination. I believe this can be explained by recalling that in 1977, such letters were produced on a typewriter, and a letter to two different companies would normally have two originals typed. It is not unreasonable to expect that a 1977 typist may have created different page breaks for the two letters, while maintaining the same content.

The Final Foundation Index map is easily identified by its file name. The files are identified as shown in the listing below.

File Name	File Properties			
	Created			Size (Bytes)
1976-1130 Geologic Mapping Procedure, Pearce to Sams (From Duke Microfilm Reel 3184).pdf	11/22/2010	05:31	PM	808,352
1976-1130 Geologic Mapping Procedure, Pearce to Sams (From LETCo Cherokee Files).pdf	11/22/2010	05:32	PM	1,975,820
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke MFS CK1108.00).pdf	11/22/2010	05:34	PM	517,068
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke Microfilm Reel 3184).pdf	11/22/2010	05:34	PM	85,621
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From LETCo Cherokee Files).pdf	11/22/2010	05:35	PM	341,589
Final Foundation Index Map (AKA Binder2 2).pdf	10/09/2006	09:27	AM	30,201,242

If you have questions, please call me at 704-382-7830.

Sincerely,

John M. McConaghy, Jr.
Engineering Consultant

Enclosure: 1 CD as described

cc: Mike Gray, FWLA (w/ enclosure)
Malcolm Schaeffer, HDR|DTA (w/ enclosure)
R.L. Morgan (w/o enclosure)
J.S. Thrasher (w/o enclosure)
J.R. Cassidy (w/o enclosure)
4000.01-09 (w/ enclosure)

ATTACHMENT 4

Duke Power Company Mapping Procedures and Addendum

Duke Power Company
Project 81
Cherokee Nuclear Station
Geologic Mapping Procedure
(November 30, 1976)
Transmitted to Law Engineering Testing Co. from Duke Power Company
[Duke File Name:1976-1130 Geologic Mapping Procedure, Pearce to Sams (From Duke Microfilm Reel 3184).pdf]

12=14
12/13

November 30, 1976

VITAL NOTES

Mr. C. E. Sams
Law Engineering Testing Co.
P. O. Box 11297
Charlotte, N. C. 28209

RE: Cherokee 1-3
Geologic Mapping
File No: CK-1108.00

Dear Mr. Sams:

Attached is a copy of the procedure we propose to use for geologic mapping at Cherokee for your review. Please plan to meet with us at the Electric Center on Monday, December 13, 1976, at 2:00 p.m. to discuss our overall mapping program at Cherokee and Law Engineering's role in that program. We can discuss any comments you might have on the procedure at that time.

Yours very truly,

L. C. Dall, Chief Engineer
Civil/Environmental Division

By: I. W. Pearce, Principal Engineer

IWP/gc

Attachment

cc: C. Q. Reeves
D. R. Privett
H. F. Schaeffer

Geologic Mapping Procedure

Outline

SECTION I - GENERAL DESCRIPTION

A. Purpose

B. Scope of Mapping and Sequence

C. Definition of Responsible Parties

1) Responsible Engineer

2) Geologist

3) Field Engineer

4) Consultant

5) Independent Geologic Consultant

D. Assignment of Responsibilities

1) Geologist

2) Field Engineer

3) Consultant

4) Independent Geologic Consultant

E. Requirements for Mapping

1) Phase I - Initial Mapping

2) Phase II - Final Excavation Mapping

SECTION II - TECHNICAL ASPECTS OF MAPPING

SECTION III - INVESTIGATING AND DOCUMENTING GEOLOGIC FAULT FEATURES

CK 1108.00

ATTACHMENT

DUKE POWER COMPANY
PROJECT 81
CHEROKEE NUCLEAR STATION
GEOLOGIC MAPPING PROCEDURE

Section I - General Description

A. PURPOSE

The purpose of the geologic mapping program for Cherokee Station is to provide a permanent record of the foundation conditions encountered in areas of safety-related structures as outlined in PSAR Section 2.5.1.2(9). This Section of the procedure outlines the relationship of responsibilities and activities between Design Engineering and Construction Departments, and the Consultants in the following areas:

Scope of Mapping and Sequence
Definition of Parties
Assignment of Responsibilities
Requirements for Mapping

B. SCOPE OF MAPPING AND SEQUENCE

The geologic mapping required by this procedure shall be performed for certain designated areas including the following major plant structures:

(1) Power Block Area - (Reactor Building, Auxiliary Building and Turbine Building Complex)
(2) Nuclear Service Water Pond Dam foundation
(3) NSW Pond Spillway Control Section foundation
(4) NSW Pump Structure foundations

The complete program of geologic mapping shall be sequenced in two basic phases depending on the extent of excavation progress.

Phase I - Scale 1"=20' - Mapping of the top of rock before blasting is started in power block area only. Detailed mapping at 1"=5' where necessary.

Phase II - Scale 1"=10' - Mapping of final excavated surfaces. Detailed mapping at 1"=5' where necessary.

When the final foundation grade is above top of rock, no Phase I mapping will be necessary. Scale for final mapping in saprolite shall not be less than 1"=20'.

CK 1108 00

C. DEFINITION OF RESPONSIBLE PARTIES

(1) Responsible Engineer - The Principal Engineer in charge of the responsible Civil Projects Section in the Civil/Environmental Division of Design Engineering Department or his designated representative.

(2) Geologist - The individual designated by Chief Engineer of Civil/Environmental Division to act as his field representative in any matters pertaining to geologic mapping.

(3) Field Engineer - The specific individual designated by the Construction Department Project Manager to be responsible for the coordination of all construction support or activities required for carrying out the geologic mapping program.

(4) Consultant - The person or persons assigned by Law Engineering and Testing Co. (LETCo) with sufficient training and experience to assist with field mapping work and review of drawings and reports when requested by the Geologist or Responsible Engineer.

(5) Independent Geologic Consultant - A third-party consultant (or consultants) with recognized expertise in the geology of the area engaged specifically for this work. This consultant will provide independent review of fault features and supporting data and conclusions where NRC notification is required for non-similar features as defined in Section III.

D. ASSIGNMENT OF RESPONSIBILITIES

All parties involved in the geologic mapping program will have general overall responsibilities to jointly support the requirement of the mapping program, to pursue their respective assignments in a timely and professional manner, and to assure that the resulting maps, data, reports, and documents are sufficient in content and accuracy to accomplish the purpose intended. The specific scope of responsibility for each of the parties for field mapping work is outlined below:

(1) Geologist -

a. Supervises and coordinates all field geologic activity involved in mapping.

b. Schedules mapping of prepared areas designated by the Field Engineer and coordinates required construction support with Field Engineer. Provides Field Engineer with estimate of time required for mapping in specific areas.

c. Determines the need for and extent of support necessary from Consultant (LETCO) and schedules personnel required for mapping.

d. Schedules and supervises as necessary all office drafting associated with preparation of geologic maps.

e. Coordinates review of field and office work, including preparation and review of reports, with Consultant (LETCO).

f. Schedules and coordinates site visits of Independent Geologic Consultant when visits are required.

g. Releases investigated areas to Field Engineer after completion of geologic mapping.

h. When designated, represents Design Engineering during NRC site visits and inspections regarding geologic matters.

(2) Field Engineer -

a. Schedules availability of areas to be mapped and assures that specific areas are cleaned and maintained until mapping is complete.

b. Coordinates earthwork operations in areas requiring mapping with Geologist and advises when areas are ready for mapping.

c. Schedules and coordinates labor, equipment, survey support, and other construction resources as necessary to assure that mapping can be completed as soon as possible.

(3) Consultant (LETCO) -

a. Provides geologist personnel support for assistance in mapping when requested by the Geologist and/or the Responsible Engineer.

b. Reviews all maps, drawings, data and reports relating to geology and foundation conditions and offers comments and suggestions as requested by the Geologist and/or the Responsible Engineer.

c. Provides other specialized assistance in personnel or services if requested by the Geologist and/or the Responsible Engineer.

(4) Independent Geologic Consultant -

a. Shall provide inspection, review and opinions pertaining to data developed for special features in consultation with Duke and Consultant (LETCO) when requested by the Geologist and/or the Responsible Engineer.

b. May provide other services as may be necessary if requested by the Responsible Engineer.

E. REQUIREMENTS FOR MAPPING

Phase I - Initial Mapping (Top of Rock)

During early construction on the site, the Geologist will monitor the overall earthmoving activities and will record in a Geologic Field Log and by use of photographs any significant observable geologic features in the areas to be mapped. At an appropriate time before rock excavation begins, the Field Engineer will notify the Geologist when an area will be ready for inspection and mapping. The Field Engineer will coordinate the necessary construction resources to prepare tha area for mapping.

Excavated areas will be mapped at elevations where earth and rock materials can no longer be removed with earthmoving equipment and blasting is required for further excavation. Preparation of an area for mapping will normally consist of a general clean-up of loose surface materials and gentle sloping of surfaces, where practicable. Limited portions of the area may have to be cleaned more thoroughly by air or water hoses, etc., to permit more detailed mapping, if features requiring detail study are found.

For areas scheduled to be mapped, the Geologist will schedule appropriate Duke Personnel and LETCO personnel, if required, to carry out the mapping in that area. In areas of exposed rock the Field Engineer will coordinate with survey crews to establish a 20 ft. grid reference system. The grid shall be plainly visible and shall be capable of being easily photographed. Iridescent type paint may be used for marking the grid and elevations shall be determined on certain grid points as requested by the Geologist to assist in map work. A 5 ft. grid may be required in some areas if determined necessary by the Geologist.

If the area to be mapped contains sloped surfaces, at greater than 30° angle from horizontal, or nearly vertical walls, the Geologist may request the Field Engineer to have the slope marked off in grids on the slope area. The Field Engineer shall also schedule and provide appropriate construction equipment or safety-ropes, etc., to allow taking of structural readings on steep slopes ás requested by the Geologist. When all mapping of an

area has been completed, the Geologist will release the area to the Field Engineer for subsequent excavation.

Phase II - Final Excavation Mapping

As the excavation of an area to be mapped nears final grade, the Field Engineer will advise the Geologist of the expected date when excavation and cleanup of the area will be complete and available for mapping. The Geologist will then determine the expected mapping completion date based on his estimate of required work for the area.

The area shall be mapped as soon as practicable after it is cleaned. Various special equipment and methods may have to be employed by the Field Engineer to maintain a mappable surface. Normally, visible 10 ft. grid reference points will be provided by the Field Engineer for Phase II mapping. The Geologist shall coordinate the mapping with the Field Engineer so that priority can be placed on any critical portions of an area.

When final mapping has been completed in the area, the Geologist will release that area to the Field Engineer for construction.

CK 1108·00

Section II - Technical Mapping Aspects

Geologic features shall be mapped at the top of rock, or Phase I mapping stage, at a scale of 1"=20' on base maps. Any detail mapping of features shall be at a scale of 1"=5'. Photographs reproduced to an appropriate scale may be used as permanent record and for checking field mapping as determined necessary by the Geologist.

In the final Phase II foundation mapping stage, structural data will be taken concurrently with the mapping effort whenever deemed necessary by the field Geologist. Density of structural readings in the powerhouse excavation should be about 2 readings per 10 ft. grid square or as many as deemed necessary by the Geologist to get a representative sample of the geologic features. The data should include measurements of the following types of geologic occurrences, where applicable:

foliation - type, strike, dip, weathering

joints - spacing, continuity, separation, roughness fill material, strike, dip

shear planes and faults - brecciation, offsets, strike, dip

contacts - rock types, weathering

As determined by the field Geologist, sufficient samples should be selected for study in thin section. The thin section data obtained should be keyed into the mapping and compared with thin section data obtained during previous studies in the area. For fault features, additional thin sections and other data may be required.

An appropriate index system shall be established to reference samples, features, and data to physical locations in the mapped areas. The system shall be suitable for cross-referencing and grouping of similar and non-similar features.

In addition, any potential problem features that may have engineering significance and will affect structure design or construction due to joints, shear zones or weathered condition of rock should be reported to the Responsible Engineer.

CK 1108.00

Section III - Investigating and Documenting Geologic Fault Features

A. INTRODUCTION

Extensive studies of fault features characteristic of the region and of the project site area have been made at the Catawba Nuclear Station (Docket Nos. 50-413 and -414) during geologic mapping and at the Cherokee project site in support of the Preliminary Safety Analysis Report for project licensing. These studies[1] establish that numerous fault features occur and can be anticipated in any large excavation in the region.

B. PURPOSE

The purpose of this section is to establish a procedure for investigating and documenting geological fault features. The fault investigation will utilize data from previous studies where applicable.

C. SCOPE

This Investigation relates directly to those geologic fault features occurring in excavations required for safety related structure foundations.

D. PROCEDURE

1. Geologic mapping will be conducted as stated in Cherokee PSAR Section 2.5.1.2(9) and Section IE and Section II of this Procedure.
2. In the event a feature as described below is discovered the (field) Geologist will promptly notify the Responsible Engineer. Features which are reportable to Responsible Engineer may include brecciated zones containing offsets and any other offsets or displaced feature of tectonic origin.
3. The Responsible Engineer will hold any structure construction in an area containing a feature as described in 2 above until a determination

---

[1] Reference: Catawba Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E
- "Final Geological Report on Brecciated Zones"
Cherokee Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E

can be made 1) that the feature is similar to features previously studied by observation and that its relevant characteristics can be determined by correlation to previously studied features or(2) that the feature is not similar to any previously studied feature and requires new investigation.

4. For similar features (described in item 3(1)), the Geologist will so notify the Responsible Engineer who will release work in the area as soon as the Geologist has indexed the feature, documented it by detailed mapping and photographs, and established the feature's similarity to a previously established feature. This similarity will be documented by comparing relevant characteristics to features observed and studied at Catawba Nuclear Station during mapping or in any of the numerous test pits opened at the Cherokee site during subsurface investigative studies. Where this similarity can be established and documented, mapping and project work will continue routinely. A tabular summary will be prepared which indexes each occurrence of a feature and makes specific comparison to a previously studied feature. Documentation will be subject to audit during field inspections by NRC.

5. For features where similarity cannot be established by comparison to features previously studied at the Cherokee or Catawba sites, the Responsible Engineer will continue to hold work in the area and notify the NRC Project Manager of the discovery. The geologic feature will then be left exposed for ten (10) days for NRC inspection.

5a. Duke with the assistance of Law Engineering Testing Company and/or other consultant will map the feature, develop data, and determine if the feature falls in the sequence of geologic events established and reported in the Cherokee PSAR.

5b. A third party, independent geologic consultant, will be engaged and will visit the site to examine the feature and examine the data developed by Duke and LETCo and/or other consultant. The Geologist will notify the Responsible Engineer (when geologic mapping, photography and field data gathering have been completed) that investigations have been completed and documented. The independent consultant will report his findings to the Responsible Engineer.

5c. If the independent geologic consultant concurs with Duke's conclusions, the Responsible Engineer will then release the area for project construction activity upon completion of item 5b.

5d. For non-similar features a report will be prepared which shall consist of the following:

(1) Description of the feature including the investigation and description of data obtained
(2) Geologic history
(3) Summary and conclusions
(4) Geologic maps and photographs
(5) Report of findings by Geologic Consultant
(6) This report and other data will be available for NRC review whenever requested.

Addendum to Mapping Procedures
(April 22, 1977)
Transmitted to Law Engineering Company and
Duke Power Company from Clemson University
[Duke File Name:1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke Microfilm Reel 3184).pdf]

APRIL 22, 1977

CK 1108·00

Mr. I. W. Pearce
Principal Engineer
Civil-Environmental Division
Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

and

Mr. C. E. Sams
Assistant Vice-President
Law Engineering Testing Company
P. O. Box 11297
Charlotte, NC 28209

Dear Sirs:

A meeting was held April 13, 1977, at Cherokee Nuclear Station for the purpose of examining bedrock features in the cleaned area in the Number 1 Turbine Building. Present at the meeting were Malcomb N. Schaeffer, Duke Power Company, Neil J. Gilbert, Law Engineering Testing Company and myself.

The meeting began with a preliminary briefing by Malcomb Schaeffer over lunch. We arrived at the site at about 1:00 PM and joined N. J. Gilbert on the cleaned area in Number 1 Turbine Building. We examined bedrock lithologies and structures and studied the 1" = 20' geologic maps prepared of the cleaned area.

After the examination of bedrock features on the site we returned to the construction site office to discuss the nature of the geologic mapping and more specifically the problems related to 1" = 5' scale mapping and what should be mapped.

The following recommendations were formulated as a result of these discussions:

1. Mapping of features at 1" = 5' scale.

   (a) There should be a minimum of 2 feet offset on a fault. This is the threshold of visibility of offset at the 1" = 20' scale.

and/or

   (b) There should be 50 feet traceable length on a fault. This is again related to a significant threshold of prominence of a structural feature on a 1" = 20' scale map.

and/or

   (c) Cataclastic zones of significant thickness. A minimum thickness of 1 foot is arbitrarily chosen.

Corollary to the above:

Combinations of greater offset with less traceable length and/or thicker

Addendum to Mapping Procedures
(April 22, 1977)
Transmitted to Law Engineering Company and
Duke Power Company from Clemson University
[Duke File Name:1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke MFS CK1108.00).pdf]

Mr. I. W. Pearce
Principal Engineer
Civil-Environmental Division
Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

and

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We returned to the site at 5:25 P.M. after the above recommendations were formulated and examined a fault previously not seen by the Independent Geologic Consultant. The above recommendations were applied to this fault and appeared to work well.

The meeting was adjourned at 6:00 P.M.

Sincerely,

Robert D. Hatcher Jr

Robert D. Hatcher, Jr.
Professor of Geology
Clemson University
Clemson, SC 29631

RDH:sr

cc: Dr. Donald T. Secor, Jr.

Duke Power Company
Project 81
Cherokee Nuclear Station
Geologic Mapping Procedure
(November 30, 1976)
Transmitted to Law Engineering Testing Co. from Duke Power Company
[Duke File Name:1976-1130 Geologic Mapping Procedure, Pearce to Sams (From LETCo Cherokee Files).pdf]

DUKE POWER COMPANY
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28201

P. O. BOX 2178

TELEPHONE: AREA 704
374-4011

November 30, 1976

COPY TO NEIL GILBERT

Mr. C. E. Sams
Law Engineering Testing Co.
P. O. Box 11297
Charlotte, N. C. 28209

RE: Cherokee 1-3
Geologic Mapping
File No: CK-1108.00

Dear Mr. Sams:

Attached is a copy of the procedure we propose to use for geologic mapping at Cherokee for your review. Please plan to meet with us at the Electric Center on ~~Monday~~ Wed, December ~~13~~ 15, 1976, at 2:00 p.m. to discuss our overall mapping program at Cherokee and Law Engineering's role in that program. We can discuss any comments you might have on the procedure at that time.

Yours very truly,

L. C. Dail, Chief Engineer
Civil/Environmental Division

By: I. W. Pearce, Principal Engineer

IWP/gc

Attachment

cc: C. Q. Reeves
D. R. Privett
M. F. Schaeffer

Geologic Mapping Procedure
Outline

SECTION I - GENERAL DESCRIPTION

A. Purpose

B. Scope of Mapping and Sequence

C. Definition of Responsible Parties

1) Responsible Engineer

2) Geologist - MALCOLM SCHAEFFER

3) Field Engineer

4) Consultant

5) Independent Geologic Consultant

D. Assignment of Responsibilities

1) Geologist

2) Field Engineer

3) Consultant

4) Independent Geologic Consultant

E. Requirements for Mapping

1) Phase I - Initial Mapping

2) Phase II - Final Excavation Mapping

SECTION II - TECHNICAL ASPECTS OF MAPPING

SECTION III - INVESTIGATING AND DOCUMENTING GEOLOGIC FAULT FEATURES

DUKE POWER COMPANY
PROJECT 81
CHEROKEE NUCLEAR STATION
GEOLOGIC MAPPING PROCEDURE

Section I - General Description

A. PURPOSE

The purpose of the geologic mapping program for Cherokee Station is to provide a permanent record of the foundation conditions encountered in areas of safety-related structures as outlined in PSAR Section 2.5.1.2(9). This Section of the procedure outlines the relationship of responsibilities and activities between Design Engineering and Construction Departments, and the Consultants in the following areas:

Scope of Mapping and Sequence
Definition of Parties
Assignment of Responsibilities
Requirements for Mapping

B. SCOPE OF MAPPING AND SEQUENCE

The geologic mapping required by this procedure shall be performed for certain designated areas including the following major plant structures:

(1) Power Block Area - (Reactor Building, Auxiliary Building and Turbine Building Complex)
(2) Nuclear Service Water Pond Dam foundation
(3) NSW Pond Spillway Control Section foundation
(4) NSW Pump Structure foundations

The complete program of geologic mapping shall be sequenced in two basic phases depending on the extent of excavation progress.

Phase I - Scale 1"=20' - Mapping of the top of rock before blasting is started in power block area only. Detailed mapping at 1"=5' where necessary.

Phase II - Scale 1"=10' - Mapping of final excavated surfaces. Detailed mapping at 1"=5' where necessary.

When the final foundation grade is above top of rock, no Phase I mapping will be necessary. Scale for final mapping in saprolite shall not be less than 1"=20'.

C. DEFINITION OF RESPONSIBLE PARTIES

(1) Responsible Engineer - The Principal Engineer in charge of the responsible Civil Projects Section in the Civil/Environmental Division of Design Engineering Department or his designated representative. T. W. PEARCE Alternate & COPeeva...

(2) Geologist - The individual designated by Chief Engineer of Civil/Environmental Division to act as his field representative in any matters pertaining to geologic mapping. MALCOLM

(3) Field Engineer - The specific individual designated by the Construction Department Project Manager to be responsible for the coordination of all construction support or activities required for carrying out the geologic mapping program.

(4) Consultant - The person or persons assigned by Law Engineering and Testing Co. (LETCo) with sufficient training and experience to assist with field mapping work and review of drawings and reports when requested by the Geologist or Responsible Engineer.

(5) Independent Geologic Consultant - A third-party consultant (or consultants) with recognized expertise in the geology of the area engaged specifically for this work. This consultant will provide independent review of fault features and supporting data and conclusions where NRC notification is required for non-similar features as defined in Section III. Bob Hatcher

D. ASSIGNMENT OF RESPONSIBILITIES

All parties involved in the geologic mapping program will have general overall responsibilities to jointly support the requirement of the mapping program, to pursue their respective assignments in a timely and professional manner, and to assure that the resulting maps, data, reports, and documents are sufficient in content and accuracy to accomplish the purpose intended. The specific scope of responsibility for each of the parties for field mapping work is outlined below:

(1) Geologist -

a. Supervises and coordinates all field geologic activity involved in mapping.

b. Schedules mapping of prepared areas designated by the Field Engineer and coordinates required construction support with Field Engineer. Provides Field Engineer with estimate of time required for mapping in specific areas.

c. Determines the need for and extent of support necessary from Consultant (LETCO) and schedules personnel required for mapping.
d. Schedules and supervises as necessary all office drafting associated with preparation of geologic maps.
e. Coordinates review of field and office work, including preparation and review of reports, with Consultant (LETCO).
f. Schedules and coordinates site visits of Independent Geologic Consultant when visits are required.
g. Releases investigated areas to Field Engineer after completion of geologic mapping.
h. When designated, represents Design Engineering during NRC site visits and inspections regarding geologic matters.

(2) Field Engineer -
a. Schedules availability of areas to be mapped and assures that specific areas are cleaned and maintained until mapping is complete.
b. Coordinates earthwork operations in areas requiring mapping with Geologist and advises when areas are ready for mapping.
c. Schedules and coordinates labor, equipment, survey support, and other construction resources as necessary to assure that mapping can be completed as soon as possible.

(3) Consultant (LETCO) -
a. Provides geologist personnel support for assistance in mapping when requested by the Geologist and/or the Responsible Engineer.
b. Reviews all maps, drawings, data and reports relating to geology and foundation conditions and offers comments and suggestions as requested by the Geologist and/or the Responsible Engineer.
c. Provides other specialized assistance in personnel or services if requested by the Geologist and/or the Responsible Engineer.

(4) Independent Geologic Consultant -
a. Shall provide inspection, review and opinions pertaining to data developed for special features in consultation with Duke and Consultant (LETCO) when requested by the Geologist and/or the Responsible Engineer.

b. May provide other services as may be necessary if requested by the Responsible Engineer.

E. REQUIREMENTS FOR MAPPING

Phase I - Initial Mapping (Top of Rock)

During early construction on the site, the Geologist will monitor the overall earthmoving activities and will record in a Geologic Field Log and by use of photographs any significant observable geologic features in the areas to be mapped. At an appropriate time before rock excavation begins, the Field Engineer will notify the Geologist when an area will be ready for inspection and mapping. The Field Engineer will coordinate the necessary construction resources to prepare tha area for mapping.

Excavated areas will be mapped at elevations where earth and rock materials can no longer be removed with earthmoving equipment and blasting is required for further excavation. Preparation of an area for mapping will normally consist of a general clean-up of loose surface materials and gentle sloping of surfaces, where practicable. Limited portions of the area may have to be cleaned more thoroughly by air or water hoses, etc., to permit more detailed mapping, if features requiring detail study are found.

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area has been completed, the Geologist will release the area to the Field Engineer for subsequent excavation.

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As the excavation of an area to be mapped nears final grade, the Field Engineer will advise the Geologist of the expected date when excavation and cleanup of the area will be complete and available for mapping. The Geologist will then determine the expected mapping completion date based on his estimate of required work for the area.

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shear planes and faults - brecciation, offsets, strike, dip

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As determined by the field Geologist, sufficient samples should be selected for study in thin section. The thin section data obtained should be keyed into the mapping and compared with thin section data obtained during previous studies in the area. For fault features, additional thin sections and other data may be required.

An appropriate index system shall be established to reference samples, features, and data to physical locations in the mapped areas. The system shall be suitable for cross-referencing and grouping of similar and non-similar features.

In addition, any potential problem features that may have engineering significance and will affect structure design or construction due to joints, shear zones or weathered condition of rock should be reported to the Responsible Engineer.

Section III - Investigating and Documenting Geologic Fault Features

A. INTRODUCTION

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B. PURPOSE

The purpose of this section is to establish a procedure for investigating and documenting geological fault features. The fault investigation will utilize data from previous studies where applicable.

C. SCOPE

This Investigation relates directly to those geologic fault features occurring in excavations required for safety related structure foundations.

D. PROCEDURE

1. Geologic mapping will be conducted as stated in Cherokee PSAR Section 2.5.1.2(9) and Section IE and Section II of this Procedure.
2. In the event a feature as described below is discovered the (field) Geologist will promptly notify the Responsible Engineer. Features which are reportable to Responsible Engineer may include brecciated zones containing offsets and any other offsets or displaced feature of tectonic origin.
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can be made 1) that the feature is similar to features previously studied by observation and that its relevant characteristics can be determined by correlation to previously studied features or(2) that the feature is not similar to any previously studied feature and requires new investigation.

4. For similar features (described in item 3(1)), the Geologist will so notify the Responsible Engineer who will release work in the area as soon as the Geologist has indexed the feature, documented it by detailed mapping and photographs, and established the feature's similarity to a previously established feature. This similarity will be documented by comparing relevant characteristics to features observed and studied at Catawba Nuclear Station during mapping or in any of the numerous test pits opened at the Cherokee site during subsurface investigative studies. Where this similarity can be established and documented, mapping and project work will continue routinely. A tabular summary will be prepared which indexes each occurrence of a feature and makes specific comparison to a previously studied feature. Documentation will be subject to audit during field inspections by NRC.

5. For features where similarity cannot be established by comparison to features previously studied at the Cherokee or Catawba sites, the Responsible Engineer will continue to hold work in the area and notify the NRC Project Manager of the discovery. The geologic feature will then be left exposed for ten (10) days for NRC inspection.

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(1) Description of the feature including the investigation and description of data obtained
(2) Geologic history
(3) Summary and conclusions
(4) Geologic maps and photographs
(5) Report of findings by Geologic Consultant
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(April 22, 1977)
Transmitted to Law Engineering Company and
Duke Power Company from Clemson University
[Duke File Name:1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From LETCo Cherokee Files).pdf]

4-27

Mr. C. E. Sams
Assistant Vice-President
Law Engineering Testing Company
P. O. Box 11297
Charlotte, NC 28209

and

Mr. I. W. Pearce
Principal Engineer
Civil-Environmental Division
Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

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Corollary to the above:

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Sincerely,

Robert D. Hatcher, Jr.
Professor of Geology
Clemson University
Clemson, SC 29631

RDH:sr

cc: Dr. Donald T. Secor, Jr.

Data Verification Summary

Data Verification Title: Cherokee Nuclear Station Service Building Final Foundation Field Maps (SB1 and SB2)
ID Number: HRQ-FWLA-002
Date of Qualification Review Team Meeting: November 12, 2010

Quality Review Team:

Name	Sign (Initials)	Organization	Qualifications
Jim Cassidy	JRC 1 Dec 2010	**Duke Energy**	**QA/QC Verification**
John McConaghy	JMM 30NOV10	**Duke Energy**	**Engineering**
Juan Vizcaya	JV	**Enercon Services Inc.**	**Engineering**
Malcolm Schaeffer	MFS	**HDR/DTA**	**Former Duke Power Project Geologist**
Michael Gray	MGG	**FWLA**	**Project Principal Geologist**
Adam Wade	AMW	**FWLA**	**Project Geologist**

Data / Evidence Considered During the Reviews:

The contents of the files outlined in attachment 2 were reviewed for applicability and completeness.

Critical Attributes Considered During the Reviews:

Files comprise the hand drawn field maps, documenting observed foundation level mapping conducted at the former Cherokee Nuclear Station (CNS) Service Building.

Basis for Qualification / Non-Qualification:

The data is qualified to use in WLS evaluations to document final foundation geology beneath former CNS Service Building. The information documented in these files were acquired, prepared, and verified using the applicable specifications and Duke QA procedures governing at the time of gathering and preparation. The CNS Service Building final foundation field geologic maps may be used in corroboration of information. These field maps will be used, in addition to the CNS Units 1 and 2 maps, as inputs to develop a final foundation map record to support geologic evaluations as part of WLS COLA.

Is the data considered Nuclear Safety Related QA Qualified? _____Yes_____ (Yes / No)

Recommendations for Additional Qualification Activities:

None

Dissenting conclusions or comments: If the team reaches concensus, enter "None" here. Otherwise, document the dissenting view as follows:
Reviewer Name and Organization: _____
Dissenting Statement: _____None_____
_____
Signature and Date: _____

I hereby certify this Data Verification Package is complete:
Quality Review Team Lead: _____ **(Sign)** **Date:** 12/02/2010

I approve this Data Verification Package for the usage identified above:
Approved By: _____ R.L. Morgan, Jr. **(Sign)** **Date:** 12/02/2010
(Duke Project Manager or designee)

Data Verification Planning Form

Data Verification Title: Cherokee Nuclear Station Service Building Final Foundation Maps (SB1 and SB2) **ID Number: HRQ-FWLA-002**

Scope of Historical Data Requiring Review:
Two hand drawn field geologic maps at 1"=10' scale of final excavated surface of the Service Building for the Cherokee Nuclear Station (CNS). Mapping was performed during CNS construction from 1977 to 1982. Attachment 1 summarizes the individual field maps to be qualified . Attachment 2 contains .pdf copies of the hand drawn map panels. Attachment 3 contains a copy of the record transmittal. Attachment 4 contains a copy of the written mapping procedures and addendum for the final excavation mapping program.

Purpose / Applicability of Data:
These field maps will be used, in addition to the CNS Units 1 and 2 maps, as inputs to develop a final foundation map record to support geologic evaluations as part of WLS COLA.

Methods of Verification (X):

Peer Review _____ Data Corroboration **X** Confirmatory Testing _____

Rationale:
The field maps generated for this project were produced using approved standards and procedures by Duke Power Company, now Duke-Energy. They represent an in-process product with status as of the time work on the Cherokee project was stopped. A copy of the Duke Power mapping procedure and addendum is provided in Attachment 4. Current-era work will compile information from these field maps to support licensing and construction of Lee Nuclear Station.

Need for Data Qualification Affirmed By: Michael Gray **Date:** 10/15/2010
FWLA Project Manager (or designee)

Required Organizations for Verification:
FWLA with support from Duke-Energy and Enercon.

Duke Approval of Scope and Methods Used: R L Morgan Jr RL Morgan, Jr **Date:** 12/02/2010
Duke Project Manager (or designee)

Attachments:
Attachment 1 Listing of Field Maps to be Qualified
Attachment 2 CNS Service Building Final Foundation Field Maps SB1 and SB2
Attachment 3 Record Transmittals
Attachment 4 Duke Power Company Mapping Procedures and Addendum

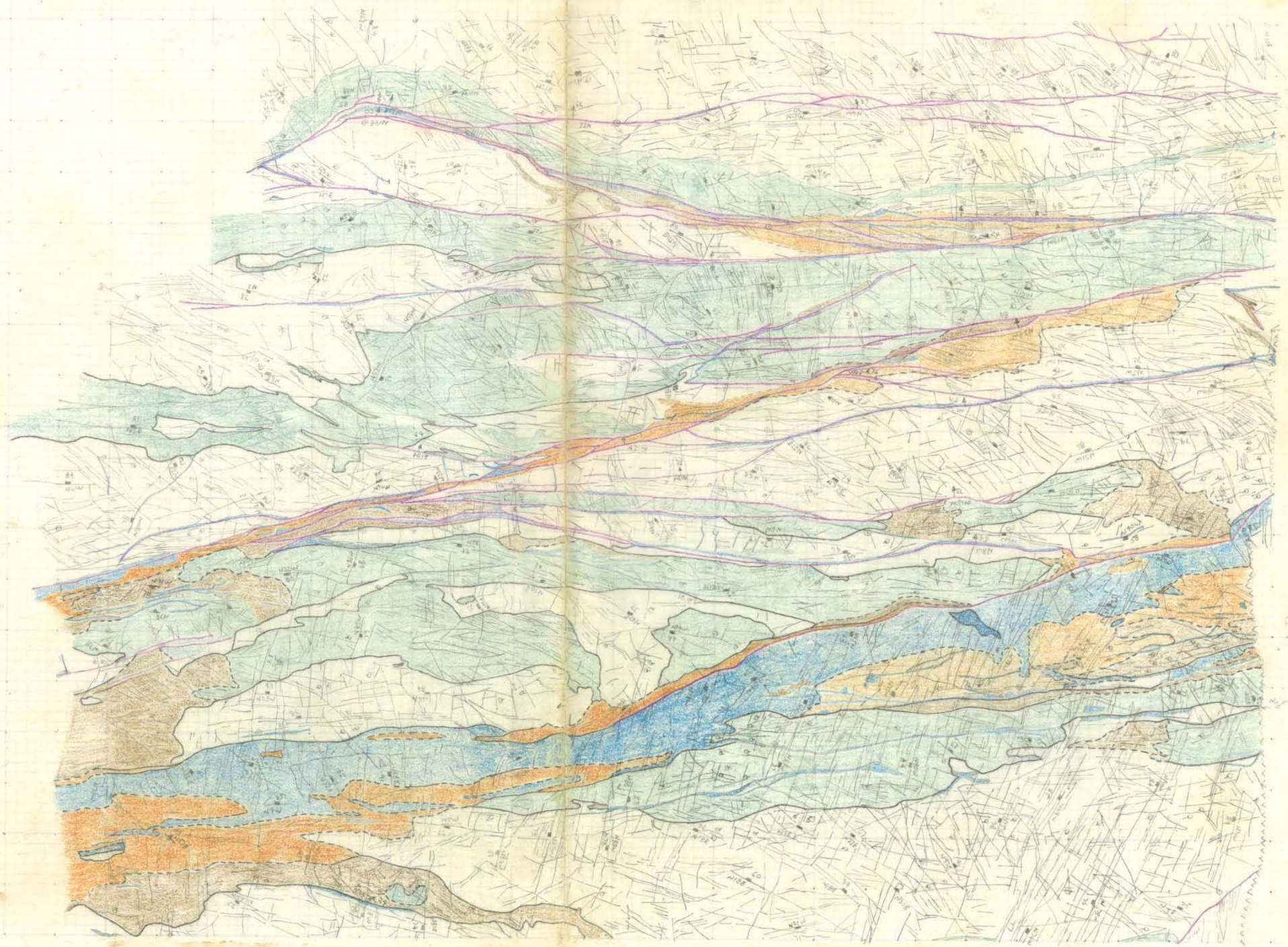
ATTACHMENT 1

Listing of Field Maps to be Qualified

Duke Energy Records Designation			CNS Records Designation	CNS Map Phase
Folder Name	File Name	Date of Transmittal	Map Panel Designation	Phase II map 1"=10'
Service Building	122_20101012.JPEG	10/13/2010	SB1	X
	123_20101012.JPEG	10/13/2010	SB2	X

ATTACHMENT 2

CNS Service Building Final Foundation Field Maps (SB1 and SB2)



ATTACHMENT 3

Record Transmittals:
Top of Rock Map Panels, Wall Map Panels, and Service Building Foundation Maps
Transmitted to FWLA from Duke Energy (October 13, 2010)

Final Foundation Index Map, Geologic Mapping Procedure, and Supplemental Mapping Guidance
Transmittal to FWLA from Duke Energy (November 23, 2010)

Duke Energy®

Rec'd 10/15/10
MGG

Duke Energy
EC09D/ 526 South Church Street
Charlotte, NC 28201-1006

Mailing Address:
P.O. Box 1006 – EC09D
Charlotte, NC 28201-1006

704-382-7830

704-382-2038 fax

October 13, 2010

Mr. Tom Slavonic
Enercon Services
4490 Old William Penn Highway
Murrysville, PA 15668

Subject: Top of Rock Map Panels, Wall Map Panels, and Service Building Foundation Maps

Dear Tom:

During our recent review of surviving Cherokee-era working documents at the Duke offices, Malcolm Schaeffer pointed out the Service Building foundation maps that had been missing during our current mapping project. Malcolm also identified complete sets of Top-of-Rock Map panels, and Wall Map panels. These items have been scanned again consistent with FWLA's needs for the mapping tasks, and the scans are contained on the attached CD. The files are identified as shown in the attached listing.

If you have questions, please call me at 704-382-7830.

Sincerely,

John M. McConaghy, Jr.
Engineering Consultant

Enclosure: 1 CD as described

cc: Mike Gray, FWLA (w/ enclosure)
Malcolm Schaeffer, HDR|DTA (w/ enclosure)
R.L. Morgan (w/o enclosure)
J.S. Thrasher (w/o enclosure)
J.R. Cassidy (w/o enclosure)
4000.01-09 (w/ enclosure)

Listing of CD Folders and Files (sheet 1 of 2)

```
 Volume in drive D is TopRock_WallMaps
 Volume Serial Number is 5973-956A

 Directory of D:\

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 Directory of D:\Additional Cherokee-Era Geologic Mapping Scans

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10/13/2010  12:35 PM    <DIR>          ..
10/13/2010  11:32 AM    <DIR>          Final Fdn Maps - CK-10 Series MLS Folder 13
10/12/2010  04:34 PM    <DIR>          Service Building
10/12/2010  04:49 PM    <DIR>          Top of Rock Maps - CK-20 Series MLS Folder 14
10/13/2010  11:28 AM    <DIR>          Wall Maps - U1 MLS Folder13, U2 MLS Folder 8
               0 File(s)              0 bytes

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Series MLS Folder 13

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20 Series MLS Folder 14

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Listing of CD Folders and Files (sheet 2 of 2)

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03/08/2007  12:03 PM        51,123,852 CK21-05A-002 Top of Rock Map Index.tif
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Folder13, U2 MLS Folder 8

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     Total Files Listed:
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```

Duke Energy
EC09D/ 526 South Church Street
Charlotte, NC 28201-1006

Mailing Address:
P.O. Box 1006 – EC09D
Charlotte, NC 28201-1006

704-382-7830

704-382-2038 fax

November 23, 2010

Mr. Tom Slavonic
Enercon Services
4490 Old William Penn Highway
Murrysville, PA 15668

Subject: Final Foundation Index Map, Geologic Mapping Procedure, and Supplemental Mapping Guidance

Dear Tom:

After our recent teleconference on qualification of Cherokee legacy geologic mapping documentation, Adam Wade pointed out that FWLA still needed to receive controlled distribution of several documents, including the Final Foundation Index Map, and the geologic mapping procedures, as well as input on those procedures from Dr. Hatcher. The attached CD contains these documents, as retrieved from several sources.

The files whose file name includes a Duke microfilm reel number were obtained from scans of microfilm records from Duke archives, and can be identified by the reel and frame number stenciled at the left of each page. The document whose name contains “MFS CK1108.00” was retrieved from Malcolm Schaeffer’s Cherokee correspondence files that are now maintained as part of the Lee project documentation. The documents containing “LETCo” in the filename were retrieved from the Law Engineering Cherokee files at MACTEC.

Comparison of the Duke and Law versions of the Geologic Mapping procedure give high confidence that the content of the two is the same, and reflects the procedures used in the field.

The Duke archive microfilm record contains only the first page of Dr. Hatcher’s letter, but it is the same as the first page of Mr. Schaeffer’s complete (two-page) document. Comparing Mr. Schaeffer’s CK1108.00 complete Hatcher document to the comparable document from Law, one can confirm that the content is the same.

The CK1108.00 version and the Law version of the Hatcher letter differ in some cosmetic ways such as pagination. I believe this can be explained by recalling that in 1977, such letters were produced on a typewriter, and a letter to two different companies would normally have two originals typed. It is not unreasonable to expect that a 1977 typist may have created different page breaks for the two letters, while maintaining the same content.

The Final Foundation Index map is easily identified by its file name. The files are identified as shown in the listing below.

File Name	File Properties			
	Created			Size (Bytes)
1976-1130 Geologic Mapping Procedure, Pearce to Sams (From Duke Microfilm Reel 3184).pdf	11/22/2010	05:31	PM	808,352
1976-1130 Geologic Mapping Procedure, Pearce to Sams (From LETCo Cherokee Files).pdf	11/22/2010	05:32	PM	1,975,820
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke MFS CK1108.00).pdf	11/22/2010	05:34	PM	517,068
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke Microfilm Reel 3184).pdf	11/22/2010	05:34	PM	85,621
1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From LETCo Cherokee Files).pdf	11/22/2010	05:35	PM	341,589
Final Foundation Index Map (AKA Binder2 2).pdf	10/09/2006	09:27	AM	30,201,242

If you have questions, please call me at 704-382-7830.

Sincerely,

John M. McConaghy, Jr.
Engineering Consultant

Enclosure: 1 CD as described

cc: Mike Gray, FWLA (w/ enclosure)
Malcolm Schaeffer, HDR|DTA (w/ enclosure)
R.L. Morgan (w/o enclosure)
J.S. Thrasher (w/o enclosure)
J.R. Cassidy (w/o enclosure)
4000.01-09 (w/ enclosure)

ATTACHMENT 4

Duke Power Company Mapping Procedures and Addendum

Duke Power Company
Project 81
Cherokee Nuclear Station
Geologic Mapping Procedure
(November 30, 1976)
Transmitted to Law Engineering Testing Co. from Duke Power Company
[Duke File Name:1976-1130 Geologic Mapping Procedure, Pearce to Sams (From Duke Microfilm Reel 3184).pdf]

12=14
12/13

November 30, 1976

VITAL NOTES

Mr. C. E. Sams
Law Engineering Testing Co.
P. O. Box 11297
Charlotte, N. C. 28209

RE: Cherokee 1-3
Geologic Mapping
File No: CK-1108.00

Dear Mr. Sams:

Attached is a copy of the procedure we propose to use for geologic mapping at Cherokee for your review. Please plan to meet with us at the Electric Center on Monday, December 13, 1976, at 2:00 p.m. to discuss our overall mapping program at Cherokee and Law Engineering's role in that program. We can discuss any comments you might have on the procedure at that time.

Yours very truly,

L. C. Dail, Chief Engineer
Civil/Environmental Division

By: I. W. Pearce, Principal Engineer

IWP/gc

Attachment

cc: C. Q. Reeves
D. R. Privett
H. F. Schaeffer

Geologic Mapping Procedure

Outline

SECTION I - GENERAL DESCRIPTION

A. Purpose

B. Scope of Mapping and Sequence

C. Definition of Responsible Parties

1) Responsible Engineer

2) Geologist

3) Field Engineer

4) Consultant

5) Independent Geologic Consultant

D. Assignment of Responsibilities

1) Geologist

2) Field Engineer

3) Consultant

4) Independent Geologic Consultant

E. Requirements for Mapping

1) Phase I - Initial Mapping

2) Phase II - Final Excavation Mapping

SECTION II - TECHNICAL ASPECTS OF MAPPING

SECTION III - INVESTIGATING AND DOCUMENTING GEOLOGIC FAULT FEATURES

CK 1108.00

ATTACHMENT

DUKE POWER COMPANY
PROJECT 81
CHEROKEE NUCLEAR STATION
GEOLOGIC MAPPING PROCEDURE

Section I - General Description

A. PURPOSE

The purpose of the geologic mapping program for Cherokee Station is to provide a permanent record of the foundation conditions encountered in areas of safety-related structures as outlined in PSAR Section 2.5.1.2(9). This Section of the procedure outlines the relationship of responsibilities and activities between Design Engineering and Construction Departments, and the Consultants in the following areas:

Scope of Mapping and Sequence
Definition of Parties
Assignment of Responsibilities
Requirements for Mapping

B. SCOPE OF MAPPING AND SEQUENCE

The geologic mapping required by this procedure shall be performed for certain designated areas including the following major plant structures:

(1) Power Block Area - (Reactor Building, Auxiliary Building and Turbine Building Complex)
(2) Nuclear Service Water Pond Dam foundation
(3) NSW Pond Spillway Control Section foundation
(4) NSW Pump Structure foundations

The complete program of geologic mapping shall be sequenced in two basic phases depending on the extent of excavation progress.

Phase I - Scale 1"=20' - Mapping of the top of rock before blasting is started in power block area only. Detailed mapping at 1"=5' where necessary.

Phase II - Scale 1"=10' - Mapping of final excavated surfaces. Detailed mapping at 1"=5' where necessary.

When the final foundation grade is above top of rock, no Phase I mapping will be necessary. Scale for final mapping in saprolite shall not be less than 1"=20'.

CK 1108 00

C. DEFINITION OF RESPONSIBLE PARTIES

(1) Responsible Engineer - The Principal Engineer in charge of the responsible Civil Projects Section in the Civil/Environmental Division of Design Engineering Department or his designated representative.

(2) Geologist - The individual designated by Chief Engineer of Civil/Environmental Division to act as his field representative in any matters pertaining to geologic mapping.

(3) Field Engineer - The specific individual designated by the Construction Department Project Manager to be responsible for the coordination of all construction support or activities required for carrying out the geologic mapping program.

(4) Consultant - The person or persons assigned by Law Engineering and Testing Co. (LETCo) with sufficient training and experience to assist with field mapping work and review of drawings and reports when requested by the Geologist or Responsible Engineer.

(5) Independent Geologic Consultant - A third-party consultant (or consultants) with recognized expertise in the geology of the area engaged specifically for this work. This consultant will provide independent review of fault features and supporting data and conclusions where NRC notification is required for non-similar features as defined in Section III.

D. ASSIGNMENT OF RESPONSIBILITIES

All parties involved in the geologic mapping program will have general overall responsibilities to jointly support the requirement of the mapping program, to pursue their respective assignments in a timely and professional manner, and to assure that the resulting maps, data, reports, and documents are sufficient in content and accuracy to accomplish the purpose intended. The specific scope of responsibility for each of the parties for field mapping work is outlined below:

(1) Geologist -

a. Supervises and coordinates all field geologic activity involved in mapping.

b. Schedules mapping of prepared areas designated by the Field Engineer and coordinates required construction support with Field Engineer. Provides Field Engineer with estimate of time required for mapping in specific areas.

CK 1108.00

c. Determines the need for and extent of support necessary from Consultant (LETCO) and schedules personnel required for mapping.

d. Schedules and supervises as necessary all office drafting associated with preparation of geologic maps.

e. Coordinates review of field and office work, including preparation and review of reports, with Consultant (LETCO).

f. Schedules and coordinates site visits of Independent Geologic Consultant when visits are required.

g. Releases investigated areas to Field Engineer after completion of geologic mapping.

h. When designated, represents Design Engineering during NRC site visits and inspections regarding geologic matters.

(2) Field Engineer -

a. Schedules availability of areas to be mapped and assures that specific areas are cleaned and maintained until mapping is complete.

b. Coordinates earthwork operations in areas requiring mapping with Geologist and advises when areas are ready for mapping.

c. Schedules and coordinates labor, equipment, survey support, and other construction resources as necessary to assure that mapping can be completed as soon as possible.

(3) Consultant (LETCO) -

a. Provides geologist personnel support for assistance in mapping when requested by the Geologist and/or the Responsible Engineer.

b. Reviews all maps, drawings, data and reports relating to geology and foundation conditions and offers comments and suggestions as requested by the Geologist and/or the Responsible Engineer.

c. Provides other specialized assistance in personnel or services if requested by the Geologist and/or the Responsible Engineer.

(4) Independent Geologic Consultant -

a. Shall provide inspection, review and opinions pertaining to data developed for special features in consultation with Duke and Consultant (LETCO) when requested by the Geologist and/or the Responsible Engineer.

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b. May provide other services as may be necessary if requested by the Responsible Engineer.

E. REQUIREMENTS FOR MAPPING

Phase I - Initial Mapping (Top of Rock)

During early construction on the site, the Geologist will monitor the overall earthmoving activities and will record in a Geologic Field Log and by use of photographs any significant observable geologic features in the areas to be mapped. At an appropriate time before rock excavation begins, the Field Engineer will notify the Geologist when an area will be ready for inspection and mapping. The Field Engineer will coordinate the necessary construction resources to prepare tha area for mapping.

Excavated areas will be mapped at elevations where earth and rock materials can no longer be removed with earthmoving equipment and blasting is required for further excavation. Preparation of an area for mapping will normally consist of a general clean-up of loose surface materials and gentle sloping of surfaces, where practicable. Limited portions of the area may have to be cleaned more thoroughly by air or water hoses, etc., to permit more detailed mapping, if features requiring detail study are found.

For areas scheduled to be mapped, the Geologist will schedule appropriate Duke Personnel and LETCO personnel, if required, to carry out the mapping in that area. In areas of exposed rock the Field Engineer will coordinate with survey crews to establish a 20 ft. grid reference system. The grid shall be plainly visible and shall be capable of being easily photographed. Iridescent type paint may be used for marking the grid and elevations shall be determined on certain grid points as requested by the Geologist to assist in map work. A 5 ft. grid may be required in some areas if determined necessary by the Geologist.

If the area to be mapped contains sloped surfaces, at greater than 30° angle from horizontal, or nearly vertical walls, the Geologist may request the Field Engineer to have the slope marked off in grids on the slope area. The Field Engineer shall also schedule and provide appropriate construction equipment or safety-ropes, etc., to allow taking of structural readings on steep slopes ás requested by the Geologist. When all mapping of an

area has been completed, the Geologist will release the area to the Field Engineer for subsequent excavation.

Phase II - Final Excavation Mapping

As the excavation of an area to be mapped nears final grade, the Field Engineer will advise the Geologist of the expected date when excavation and cleanup of the area will be complete and available for mapping. The Geologist will then determine the expected mapping completion date based on his estimate of required work for the area.

The area shall be mapped as soon as practicable after it is cleaned. Various special equipment and methods may have to be employed by the Field Engineer to maintain a mappable surface. Normally, visible 10 ft. grid reference points will be provided by the Field Engineer for Phase II mapping. The Geologist shall coordinate the mapping with the Field Engineer so that priority can be placed on any critical portions of an area.

When final mapping has been completed in the area, the Geologist will release that area to the Field Engineer for construction.

CK 1108·00

Section II - Technical Mapping Aspects

Geologic features shall be mapped at the top of rock, or Phase I mapping stage, at a scale of 1"=20' on base maps. Any detail mapping of features shall be at a scale of 1"=5'. Photographs reproduced to an appropriate scale may be used as permanent record and for checking field mapping as determined necessary by the Geologist.

In the final Phase II foundation mapping stage, structural data will be taken concurrently with the mapping effort whenever deemed necessary by the field Geologist. Density of structural readings in the powerhouse excavation should be about 2 readings per 10 ft. grid square or as many as deemed necessary by the Geologist to get a representative sample of the geologic features. The data should include measurements of the following types of geologic occurrences, where applicable:

foliation - type, strike, dip, weathering

joints - spacing, continuity, separation, roughness fill material, strike, dip

shear planes and faults - brecciation, offsets, strike, dip

contacts - rock types, weathering

As determined by the field Geologist, sufficient samples should be selected for study in thin section. The thin section data obtained should be keyed into the mapping and compared with thin section data obtained during previous studies in the area. For fault features, additional thin sections and other data may be required.

An appropriate index system shall be established to reference samples, features, and data to physical locations in the mapped areas. The system shall be suitable for cross-referencing and grouping of similar and non-similar features.

In addition, any potential problem features that may have engineering significance and will affect structure design or construction due to joints, shear zones or weathered condition of rock should be reported to the Responsible Engineer.

Section III - Investigating and Documenting Geologic Fault Features

A. INTRODUCTION

Extensive studies of fault features characteristic of the region and of the project site area have been made at the Catawba Nuclear Station (Docket Nos. 50-413 and -414) during geologic mapping and at the Cherokee project site in support of the Preliminary Safety Analysis Report for project licensing. These studies[1] establish that numerous fault features occur and can be anticipated in any large excavation in the region.

B. PURPOSE

The purpose of this section is to establish a procedure for investigating and documenting geological fault features. The fault investigation will utilize data from previous studies where applicable.

C. SCOPE

This Investigation relates directly to those geologic fault features occurring in excavations required for safety related structure foundations.

D. PROCEDURE

1. Geologic mapping will be conducted as stated in Cherokee PSAR Section 2.5.1.2(9) and Section IE and Section II of this Procedure.
2. In the event a feature as described below is discovered the (field) Geologist will promptly notify the Responsible Engineer. Features which are reportable to Responsible Engineer may include brecciated zones containing offsets and any other offsets or displaced feature of tectonic origin.
3. The Responsible Engineer will hold any structure construction in an area containing a feature as described in 2 above until a determination

---

[1] Reference: Catawba Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E
- "Final Geological Report on Brecciated Zones"
Cherokee Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E

can be made 1) that the feature is similar to features previously studied by observation and that its relevant characteristics can be determined by correlation to previously studied features or(2) that the feature is not similar to any previously studied feature and requires new investigation.

4. For similar features (described in item 3(1)), the Geologist will so notify the Responsible Engineer who will release work in the area as soon as the Geologist has indexed the feature, documented it by detailed mapping and photographs, and established the feature's similarity to a previously established feature. This similarity will be documented by comparing relevant characteristics to features observed and studied at Catawba Nuclear Station during mapping or in any of the numerous test pits opened at the Cherokee site during subsurface investigative studies. Where this similarity can be established and documented, mapping and project work will continue routinely. A tabular summary will be prepared which indexes each occurrence of a feature and makes specific comparison to a previously studied feature. Documentation will be subject to audit during field inspections by NRC.

5. For features where similarity cannot be established by comparison to features previously studied at the Cherokee or Catawba sites, the Responsible Engineer will continue to hold work in the area and notify the NRC Project Manager of the discovery. The geologic feature will then be left exposed for ten (10) days for NRC inspection.

5a. Duke with the assistance of Law Engineering Testing Company and/or other consultant will map the feature, develop data, and determine if the feature falls in the sequence of geologic events established and reported in the Cherokee PSAR.

5b. A third party, independent geologic consultant, will be engaged and will visit the site to examine the feature and examine the data developed by Duke and LETCo and/or other consultant. The Geologist will notify the Responsible Engineer (when geologic mapping, photography and field data gathering have been completed) that investigations have been completed and documented. The independent consultant will report his findings to the Responsible Engineer.

CK-1108-00

5c. If the independent geologic consultant concurs with Duke's conclusions, the Responsible Engineer will then release the area for project construction activity upon completion of item 5b.

5d. For non-similar features a report will be prepared which shall consist of the following:

(1) Description of the feature including the investigation and description of data obtained
(2) Geologic history
(3) Summary and conclusions
(4) Geologic maps and photographs
(5) Report of findings by Geologic Consultant
(6) This report and other data will be available for NRC review whenever requested.

Addendum to Mapping Procedures
(April 22, 1977)
Transmitted to Law Engineering Company and
Duke Power Company from Clemson University
[Duke File Name:1977-0422 Geo Mapping Letter, Hatcher to Sams and Pearce (From Duke Microfilm Reel 3184).pdf]

APRIL 22, 1977

CK 1108·00

Mr. I. W. Pearce
Principal Engineer
Civil-Environmental Division
Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

and

Mr. C. E. Sams
Assistant Vice-President
Law Engineering Testing Company
P. O. Box 11297
Charlotte, NC 28209

Dear Sirs:

A meeting was held April 13, 1977, at Cherokee Nuclear Station for the purpose of examining bedrock features in the cleaned area in the Number 1 Turbine Building. Present at the meeting were Malcomb N. Schaeffer, Duke Power Company, Neil J. Gilbert, Law Engineering Testing Company and myself.

The meeting began with a preliminary briefing by Malcomb Schaeffer over lunch. We arrived at the site at about 1:00 PM and joined N. J. Gilbert on the cleaned area in Number 1 Turbine Building. We examined bedrock lithologies and structures and studied the 1" = 20' geologic maps prepared of the cleaned area.

After the examination of bedrock features on the site we returned to the construction site office to discuss the nature of the geologic mapping and more specifically the problems related to 1" = 5' scale mapping and what should be mapped.

The following recommendations were formulated as a result of these discussions:

1. Mapping of features at 1" = 5' scale.

   (a) There should be a minimum of 2 feet offset on a fault. This is the threshold of visibility of offset at the 1" = 20' scale.

and/or

   (b) There should be 50 feet traceable length on a fault. This is again related to a significant threshold of prominence of a structural feature on a 1" = 20' scale map.

and/or

   (c) Cataclastic zones of significant thickness. A minimum thickness of 1 foot is arbitrarily chosen.

Corollary to the above:

Combinations of greater offset with less traceable length and/or thicker

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We returned to the site at 5:25 P.M. after the above recommendations were formulated and examined a fault previously not seen by the Independent Geologic Consultant. The above recommendations were applied to this fault and appeared to work well.

The meeting was adjourned at 6:00 P.M.

Sincerely,

Robert D. Hatcher Jr

Robert D. Hatcher, Jr.
Professor of Geology
Clemson University
Clemson, SC 29631

RDH:sr

cc: Dr. Donald T. Secor, Jr.

Duke Power Company
Project 81
Cherokee Nuclear Station
Geologic Mapping Procedure
(November 30, 1976)
Transmitted to Law Engineering Testing Co. from Duke Power Company
[Duke File Name:1976-1130 Geologic Mapping Procedure, Pearce to Sams (From LETCo Cherokee Files).pdf]

DUKE POWER COMPANY
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28201

P. O. BOX 2178

TELEPHONE: AREA 704
374-4011

November 30, 1976

COPY TO NEIL GILBERT

Mr. C. E. Sams
Law Engineering Testing Co.
P. O. Box 11297
Charlotte, N. C. 28209

RE: Cherokee 1-3
Geologic Mapping
File No: CK-1108.00

Dear Mr. Sams:

Attached is a copy of the procedure we propose to use for geologic mapping at Cherokee for your review. Please plan to meet with us at the Electric Center on ~~Monday~~ Wed, December ~~13~~ 15, 1976, at 2:00 p.m. to discuss our overall mapping program at Cherokee and Law Engineering's role in that program. We can discuss any comments you might have on the procedure at that time.

Yours very truly,

L. C. Dail, Chief Engineer
Civil/Environmental Division

By: I. W. Pearce, Principal Engineer

IWP/gc

Attachment

cc: C. Q. Reeves
D. R. Privett
M. F. Schaeffer

Geologic Mapping Procedure
Outline

SECTION I - GENERAL DESCRIPTION

A. Purpose

B. Scope of Mapping and Sequence

C. Definition of Responsible Parties

1) Responsible Engineer

2) Geologist - MALCOLM SCHAEFFER

3) Field Engineer

4) Consultant

5) Independent Geologic Consultant

D. Assignment of Responsibilities

1) Geologist

2) Field Engineer

3) Consultant

4) Independent Geologic Consultant

E. Requirements for Mapping

1) Phase I - Initial Mapping

2) Phase II - Final Excavation Mapping

SECTION II - TECHNICAL ASPECTS OF MAPPING

SECTION III - INVESTIGATING AND DOCUMENTING GEOLOGIC FAULT FEATURES

DUKE POWER COMPANY
PROJECT 81
CHEROKEE NUCLEAR STATION
GEOLOGIC MAPPING PROCEDURE

Section I - General Description

A. PURPOSE

The purpose of the geologic mapping program for Cherokee Station is to provide a permanent record of the foundation conditions encountered in areas of safety-related structures as outlined in PSAR Section 2.5.1.2(9). This Section of the procedure outlines the relationship of responsibilities and activities between Design Engineering and Construction Departments, and the Consultants in the following areas:

Scope of Mapping and Sequence
Definition of Parties
Assignment of Responsibilities
Requirements for Mapping

B. SCOPE OF MAPPING AND SEQUENCE

The geologic mapping required by this procedure shall be performed for certain designated areas including the following major plant structures:

(1) Power Block Area - (Reactor Building, Auxiliary Building and Turbine Building Complex)
(2) Nuclear Service Water Pond Dam foundation
(3) NSW Pond Spillway Control Section foundation
(4) NSW Pump Structure foundations

The complete program of geologic mapping shall be sequenced in two basic phases depending on the extent of excavation progress.

Phase I - Scale 1"=20' - Mapping of the top of rock before blasting is started in power block area only. Detailed mapping at 1"=5' where necessary.

Phase II - Scale 1"=10' - Mapping of final excavated surfaces. Detailed mapping at 1"=5' where necessary.

When the final foundation grade is above top of rock, no Phase I mapping will be necessary. Scale for final mapping in saprolite shall not be less than 1"=20'.

C. DEFINITION OF RESPONSIBLE PARTIES

(1) Responsible Engineer - The Principal Engineer in charge of the responsible Civil Projects Section in the Civil/Environmental Division of Design Engineering Department or his designated representative. T. W. PEARCE Alternate C.O.P.

(2) Geologist - The individual designated by Chief Engineer of Civil/Environmental Division to act as his field representative in any matters pertaining to geologic mapping. MALCOLM

(3) Field Engineer - The specific individual designated by the Construction Department Project Manager to be responsible for the coordination of all construction support or activities required for carrying out the geologic mapping program.

(4) Consultant - The person or persons assigned by Law Engineering and Testing Co. (LETCo) with sufficient training and experience to assist with field mapping work and review of drawings and reports when requested by the Geologist or Responsible Engineer.

(5) Independent Geologic Consultant - A third-party consultant (or consultants) with recognized expertise in the geology of the area engaged specifically for this work. This consultant will provide independent review of fault features and supporting data and conclusions where NRC notification is required for non-similar features as defined in Section III. Bob Hatcher

D. ASSIGNMENT OF RESPONSIBILITIES

All parties involved in the geologic mapping program will have general overall responsibilities to jointly support the requirement of the mapping program, to pursue their respective assignments in a timely and professional manner, and to assure that the resulting maps, data, reports, and documents are sufficient in content and accuracy to accomplish the purpose intended. The specific scope of responsibility for each of the parties for field mapping work is outlined below:

(1) Geologist -

a. Supervises and coordinates all field geologic activity involved in mapping.

b. Schedules mapping of prepared areas designated by the Field Engineer and coordinates required construction support with Field Engineer. Provides Field Engineer with estimate of time required for mapping in specific areas.

c. Determines the need for and extent of support necessary from Consultant (LETCO) and schedules personnel required for mapping.
d. Schedules and supervises as necessary all office drafting associated with preparation of geologic maps.
e. Coordinates review of field and office work, including preparation and review of reports, with Consultant (LETCO).
f. Schedules and coordinates site visits of Independent Geologic Consultant when visits are required.
g. Releases investigated areas to Field Engineer after completion of geologic mapping.
h. When designated, represents Design Engineering during NRC site visits and inspections regarding geologic matters.

(2) Field Engineer -
a. Schedules availability of areas to be mapped and assures that specific areas are cleaned and maintained until mapping is complete.
b. Coordinates earthwork operations in areas requiring mapping with Geologist and advises when areas are ready for mapping.
c. Schedules and coordinates labor, equipment, survey support, and other construction resources as necessary to assure that mapping can be completed as soon as possible.

(3) Consultant (LETCO) -
a. Provides geologist personnel support for assistance in mapping when requested by the Geologist and/or the Responsible Engineer.
b. Reviews all maps, drawings, data and reports relating to geology and foundation conditions and offers comments and suggestions as requested by the Geologist and/or the Responsible Engineer.
c. Provides other specialized assistance in personnel or services if requested by the Geologist and/or the Responsible Engineer.

(4) Independent Geologic Consultant -
a. Shall provide inspection, review and opinions pertaining to data developed for special features in consultation with Duke and Consultant (LETCO) when requested by the Geologist and/or the Responsible Engineer.

b. May provide other services as may be necessary if requested by the Responsible Engineer.

E. REQUIREMENTS FOR MAPPING

Phase I - Initial Mapping (Top of Rock)

During early construction on the site, the Geologist will monitor the overall earthmoving activities and will record in a Geologic Field Log and by use of photographs any significant observable geologic features in the areas to be mapped. At an appropriate time before rock excavation begins, the Field Engineer will notify the Geologist when an area will be ready for inspection and mapping. The Field Engineer will coordinate the necessary construction resources to prepare tha area for mapping.

Excavated areas will be mapped at elevations where earth and rock materials can no longer be removed with earthmoving equipment and blasting is required for further excavation. Preparation of an area for mapping will normally consist of a general clean-up of loose surface materials and gentle sloping of surfaces, where practicable. Limited portions of the area may have to be cleaned more thoroughly by air or water hoses, etc., to permit more detailed mapping, if features requiring detail study are found.

For areas scheduled to be mapped, the Geologist will schedule appropriate Duke Personnel and LETCO personnel, if required, to carry out the mapping in that area. In areas of exposed rock the Field Engineer will coordinate with survey crews to establish a 20 ft. grid reference system. The grid shall be plainly visible and shall be capable of being easily photographed. Iridescent type paint may be used for marking the grid and elevations shall be determined on certain grid points as requested by the Geologist to assist in map work. A 5 ft. grid may be required in some areas if determined necessary by the Geologist.

If the area to be mapped contains sloped surfaces, at greater than 30° angle from horizontal, or nearly vertical walls, the Geologist may request the Field Engineer to have the slope marked off in grids on the slope area. The Field Engineer shall also schedule and provide appropriate construction equipment or safety-ropes, etc., to allow taking of structural readings on steep slopes ás requested by the Geologist. When all mapping of an

area has been completed, the Geologist will release the area to the Field Engineer for subsequent excavation.

Phase II - Final Excavation Mapping

As the excavation of an area to be mapped nears final grade, the Field Engineer will advise the Geologist of the expected date when excavation and cleanup of the area will be complete and available for mapping. The Geologist will then determine the expected mapping completion date based on his estimate of required work for the area.

The area shall be mapped as soon as practicable after it is cleaned. Various special equipment and methods may have to be employed by the Field Engineer to maintain a mappable surface. Normally, visible 10 ft. grid reference points will be provided by the Field Engineer for Phase II mapping. The Geologist shall coordinate the mapping with the Field Engineer so that priority can be placed on any critical portions of an area.

When final mapping has been completed in the area, the Geologist will release that area to the Field Engineer for construction.

Section II - Technical Mapping Aspects

Geologic features shall be mapped at the top of rock, or Phase I mapping stage, at a scale of 1"=20' on base maps. Any detail mapping of features shall be at a scale of 1"=5'. Photographs reproduced to an appropriate scale may be used as permanent record and for checking field mapping as determined necessary by the Geologist.

In the final Phase II foundation mapping stage, structural data will be taken concurrently with the mapping effort whenever deemed necessary by the field Geologist. Density of structural readings in the powerhouse excavation should be about 2 readings per 10 ft. grid square or as many as deemed necessary by the Geologist to get a representative sample of the geologic features. The data should include measurements of the following types of geologic occurrences, where applicable:

foliation - type, strike, dip, weathering

joints - spacing, continuity, separation, roughness fill material, strike, dip

shear planes and faults - brecciation, offsets, strike, dip

contacts - rock types, weathering

As determined by the field Geologist, sufficient samples should be selected for study in thin section. The thin section data obtained should be keyed into the mapping and compared with thin section data obtained during previous studies in the area. For fault features, additional thin sections and other data may be required.

An appropriate index system shall be established to reference samples, features, and data to physical locations in the mapped areas. The system shall be suitable for cross-referencing and grouping of similar and non-similar features.

In addition, any potential problem features that may have engineering significance and will affect structure design or construction due to joints, shear zones or weathered condition of rock should be reported to the Responsible Engineer.

Section III - Investigating and Documenting Geologic Fault Features

A. INTRODUCTION

Extensive studies of fault features characteristic of the region and of the project site area have been made at the Catawba Nuclear Station (Docket Nos. 50-413 and -414) during geologic mapping and at the Cherokee project site in support of the Preliminary Safety Analysis Report for project licensing. These studies[1] establish that numerous fault features occur and can be anticipated in any large excavation in the region.

B. PURPOSE

The purpose of this section is to establish a procedure for investigating and documenting geological fault features. The fault investigation will utilize data from previous studies where applicable.

C. SCOPE

This Investigation relates directly to those geologic fault features occurring in excavations required for safety related structure foundations.

D. PROCEDURE

1. Geologic mapping will be conducted as stated in Cherokee PSAR Section 2.5.1.2(9) and Section IE and Section II of this Procedure.
2. In the event a feature as described below is discovered the (field) Geologist will promptly notify the Responsible Engineer. Features which are reportable to Responsible Engineer may include brecciated zones containing offsets and any other offsets or displaced feature of tectonic origin.
3. The Responsible Engineer will hold any structure construction in an area containing a feature as described in 2 above until a determination

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[1] Reference: Catawba Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E
- "Final Geological Report on Brecciated Zones"
Cherokee Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E

can be made 1) that the feature is similar to features previously studied by observation and that its relevant characteristics can be determined by correlation to previously studied features or(2) that the feature is not similar to any previously studied feature and requires new investigation.

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4-27

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Assistant Vice-President
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P. O. Box 11297
Charlotte, NC 28209

and

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Principal Engineer
Civil-Environmental Division
Duke Power Company
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RDH:sr

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