

Managing Bridge Data using DataHub

Bridging Big Data | Omaha, Nebraska | 30 November 2016

Lucas Laughery and Santiago Pujol

Lyles School of Civil Engineering, Purdue University

Challenges

Hundreds of thousands of bridges

Different decks, superstructures, substructures, sites

Different traffic volumes

Different inspection intervals

Different maintenance histories

...

Large amount of data over time

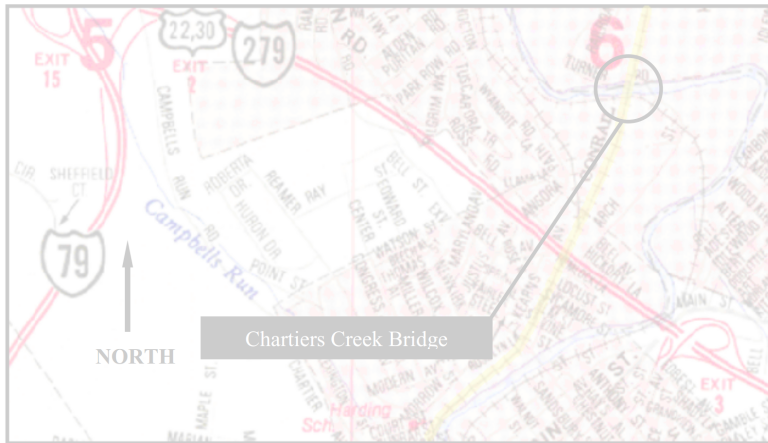
Big Data in a Small Format

317 NKA-MF-0021420000000004500000Mirage Flats Canal Lembke Rd
Approx 16 miles
southwest99990005117000000000000004228037910252188000730269091990020000000502010
5005000000000500000000000A15101000002000099900049000107000000005000509990N0000N
0000006646N232723274NN4873810000000031224N N N
0522000000000522002010 0 0 0N3 00000018001501Y80000082030 NY
1 06251

317 NKA-MF-0101410047000016100000Mirage Flats Canal 470 Lane
12 miles east-northeast
0999900220430000000000000042310019102440053001302690919900200000050201050049000
000005N0000000000A15101000001000004900076000076000000004900499990N0000N000000077
67N5327532763N5773810000000031224N N N 03720000000000372002010
0 0 0N2 00000018001501Y800000102030 NY
2 08552

317 NKA-RW-0021480000000014500000Red Willow Canal County Road 720
7.2 miles north east of
M999900000000000000000000040154788100305828001321690919550200000005201050062010
00000400000000000A15702000002000005900070000140002002005900629990N0000N000000045
55N2381226354N577 2000000031224N N N 000000000000000506002010
0 0 0N2 0000008700150 Y80000062030 NY
1 07611





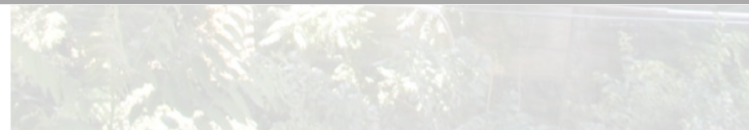
**PORT AUTHORITY OF ALLEGHENY COUNTY
PITTSBURGH, PENNSYLVANIA**

**REPORT ON THE
NBIS INSPECTION
OF
CHARTIERS CREEK BRIDGE**

BMS No. 02 7421 0000 9061

Submitted By:
Michael Baker Jr., Inc.
100 Airside Drive
Coraopolis, Pennsylvania
15108

September, 2011



Site Data BRIDGE MANAGEMENT SYSTEM

CHARTIERS CREEK BRIDGE

Structure Type (Dist) STL INVERTED-I-BEAM

Time taken: 7:30 A.M. Weather Conditions: 94

CRAMTON Time taken: 4:30 P.M. MOSTLY SUNNY

BMS Item	Type of Sign	Required Sign	Near Advance	Bridge Sign	Far Advance	Comments
D15	Bridge Weight Limit	NA - T				NONE POSTED
D15	Export Combination	NA - T				
D14	One Truck at a Time	Yes				See Sketch
E0202	Vert. Clearance - Gr.	NA				See Sketch
E0203	Vert. Clearance - Ltd.	NA				See Sketch
	One Lane Bridge	Yes	(S)	(S)	(S)	
	Narrow Bridge	Yes	(S)	(S)	(S)	
	Hazard Clearance	Yes	(S)	(S)	(S)	
	Other					

Underclearance Appraisal: 12'2" Vertical, 36'7" Horizontal

Traffic Safety Features: PARAPET - JERSEY BARRIER (GOOD CONDITION - MINOR CRACKING THROUGHOUT), PARAPET EXTENSIONS

Approach Roadway: GOOD, NEW PAVEMENT GOOD CONDITION

Approach Shoulder: NEW CONSTRUCTION

Relief Joint: 1

IV. STRUCTURAL ANALYSIS:

Bridge Load Ratings (Tons)

LOAD FACTOR	H	HS	ML	P
Inventory w/o F.W.S	115	159	152	---
Inventory w/ F.W.S	112	155	148	---
Operating w/o F.W.S	191	265	253	346
Operating w/ F.W.S	187	259	247	338

Note: 1) Critical rating is for a beam controlled by shear in span 3
2) Due to no analysis being performed as part of the inspection, the above table is reproduced from contract drawings.

V. RECOMMENDATIONS AND COST ESTIMATE:

Repairs

Item	Estimated Quantity	Unit Cost	Total Cost
Drain junction boxes, and conduits filled with water. Repair bent conduits, and broken couplers/adapters.	N/A	Lump Sum	\$7,500.00
Paint locations requiring final paint coat between girders 3 & 4 in span 2.	20 SF	Lump Sum	\$1,500.00

TOTAL COST \$9,000.00

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 0021420000000004500000Mirage
 Flats Canal Lembke Rd
 Approx 16 miles
 southwest99990005117000000000000
 04228037910252188000730269091990
 020000005020105005000000000050000
 000000A1510100000200009990004900
 0107000000005000509990N0000N0000
 006646N232723274NN48738100000003
 1224N N N
 0522000000000522002010 0 0
 0N3 00000018001501Y800000082030
 NY
 1 06251

Information for Many Bridges

Required by FHWA for NBI.



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Files for Each Bridge
 Managed by bridge owners.
 Different from state-to-state.



How?

- Human-readable organization
- Links
- Parameters
- Exploration tools

How?

- Data are organized in a **table**
- Each **row** corresponds to one **case**
- Each **column** contains information/files for that case
 - **Information** that describes
what, when, where, who?

~~Only report(s) with the word "Interpretation" in the title~~ **Only report(s) with the word "Interpretation" in the title** →

Download Exit Fullscreen Clear Filters No-Wrap Maps

Use search boxes above columns to filter data

Show 10 entries First Previous 1 2 3 4 5 Next Last Search:

Id	Title	Experiment or Case ID	Keywords	Report(s)	Parameters	Data	Photos, Videos, etc.
Search	<input type="text" value="Search Title"/>	<input type="text" value="Search Experiment"/>	<input type="text" value="Search Keywords"/>	<input type="text" value="Search Report(s)"/>	<input type="text" value="Search Parameters"/>	<input type="text" value="Search Data"/>	<input type="text" value="Search Photos, Videos, etc."/>
8942	I-465 Over I-69 Bridge	I-465, I-69 Intersection IN	I-465 I-69 IN	View 1 report(s)	-	View 4 file(s)	View 3 media
8943	US-41 White River Bridge	US-41 White River IN	Structural Engineering Steel Bridge Data Bridge Evaluation	View 1 report(s)	-	View 3 file(s)	View 1 media
8944	US-421 Madison Bridge	US-421 Madison Milton IN	Structural Engineering Steel Bridge Data Bridge Evaluation	View 2 report(s)	-	View 4 file(s)	View 1 media
8945	Silver Bridge	US-35 Point Pleasant WV	Structural Engineering Steel Bridge Data US 35	-	-	View 2 file(s)	-
8946	I-95 Yellow Mill Pond Bridge	I-95 Yellow Mill Pond CT	Structural Engineering Steel Bridge Data I 95	-	-	View 4 file(s)	-
8947	I-91 Quinnipiac River Bridge	I-91 Quinnipiac River CT	Structural Engineering Steel Bridge Data I 91	-	-	View 3 file(s)	View 2 media
8948	Chicago Dan Ryan Bent Bridge	Chicago CTA Dan Ryan IL	Structural Engineering Steel Bridge Data "	-	-	View 4 file(s)	View 1 media
8949	I-79 Neville Island Bridge	I-79 Neville Island PA	Structural Engineering Steel Bridge Data	-	-	View 4 file(s)	-

Every column is searchable or interactive.

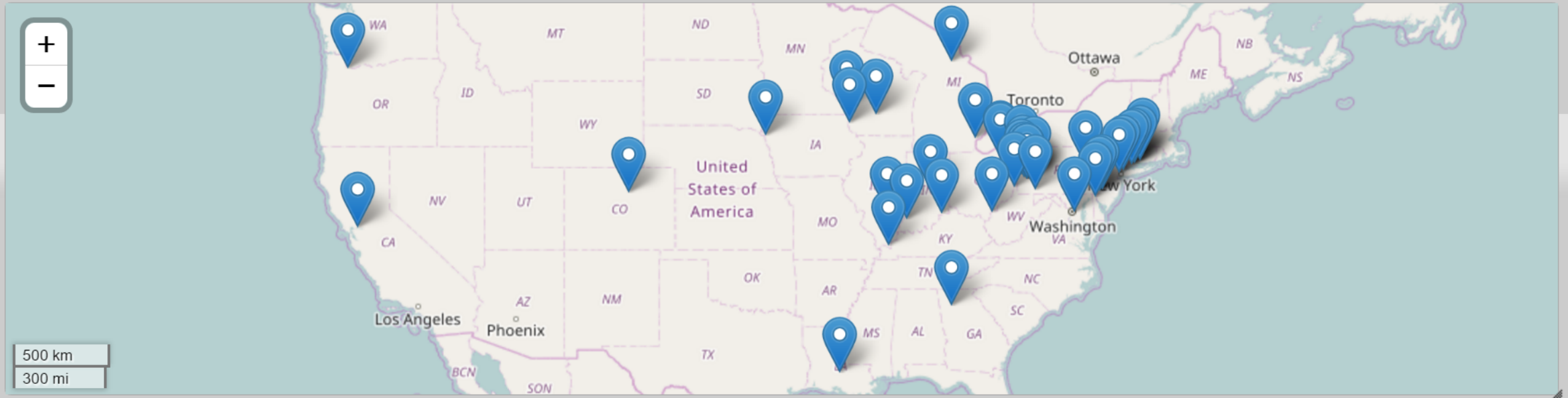
Steel Bridge Database

Download Exit Fullscreen Clear Filters No-Wrap **Maps**

Use search boxes above columns to filter data i

Reload Map

KML KMZ SHP



Show 100 entries

First Previous 1 Next Last

Search:

Id	Title	Experiment or Case ID	Keywords	Report(s)	Parameters	Data	Photos, Videos, etc.
<input type="text" value="Search"/>	<input type="text" value="Search Title"/>	<input type="text" value="Search Experiment"/>	<input type="text" value="Search Keywords"/>	<input type="text" value="Search Report(s)"/>	<input type="text" value="Search Parameters"/>	<input type="text" value="Search Data"/>	<input type="text" value="Search Photos, Videos, etc."/>
8942	I-465 Over I-69 Bridge	I-465, I-69 Intersection IN	Structural Engineering Steel Bridge Data Bridge Evaluation	View 1 report(s)	-	View 4 file(s)	View 3 media
8943	US-41 White River Bridge	US-41 White River IN	Structural Engineering Steel Bridge Data	View 1 report(s)	-	View 3 file(s)	View 1 media

How?

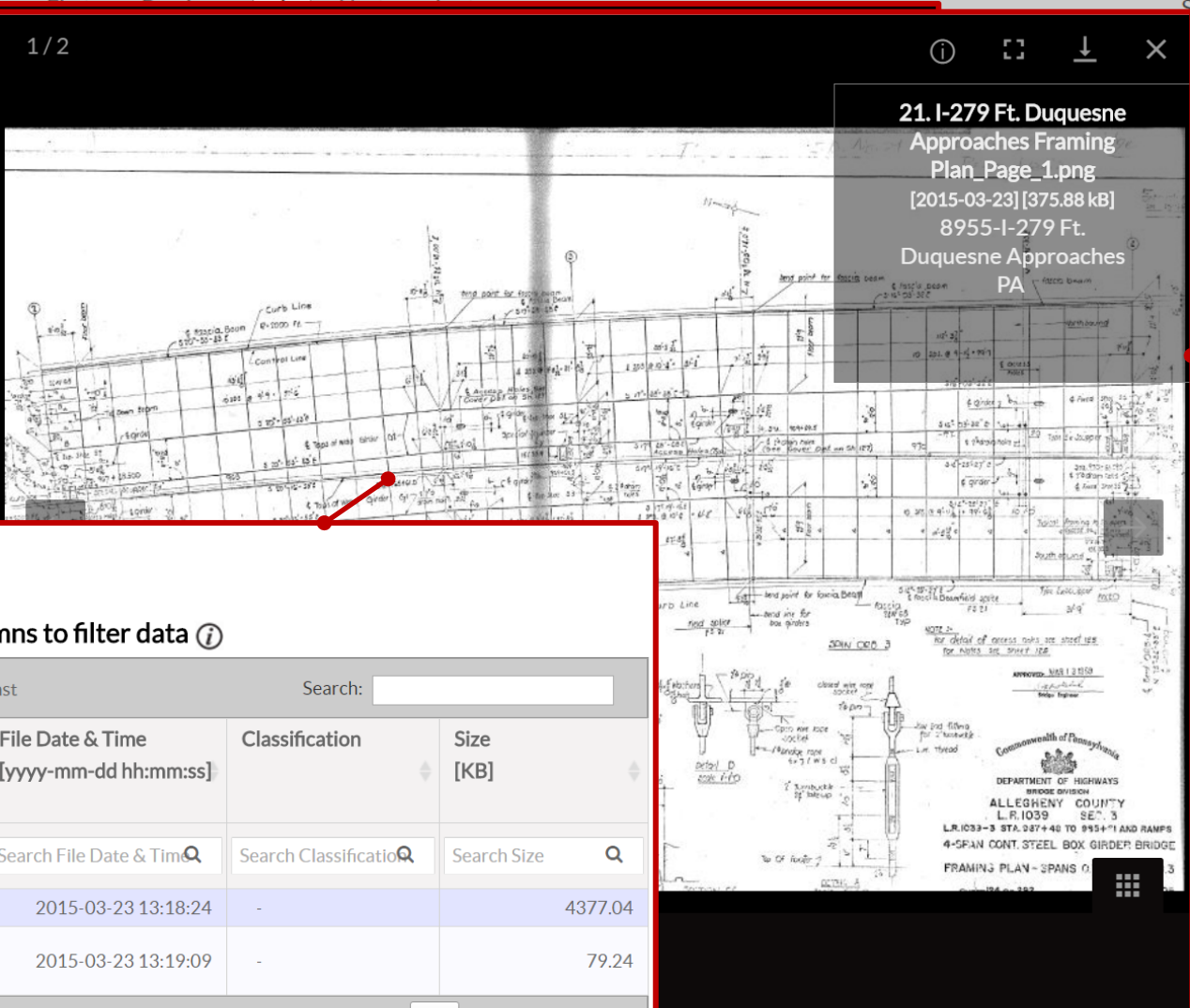
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 - **File collections** that can be *explored*

Download Exit Fullscreen Clear Filters No-Wrap Maps

Use search boxes above columns to filter data

Show 100 entries

Id	Title
Search	Search Title
8942	I-465 Over I-69 Bridge
8943	US-41 White River Bridge
8944	US-421 Madison Bridge



Search:

- Drawings/Diagrams
- Search Drawings/Diagrams
- View 2 drawing(s)
- View 4 drawing(s)
- View 10 drawing(s)
- View 11 drawing(s)
- View 3 drawing(s)
- View 5 drawing(s)
- View 6 drawing(s)
- View 3 file(s)
- View 2 drawing(s)

Reports Explorer

Fullscreen Clear Filters No-Wrap

Use search boxes above columns to filter data

Show 10 entries

First Previous 1 Next Last Search:

File Id	File Name	File Description	File Date & Time [yyyy-mm-dd hh:mm:ss]	Classification	Size [KB]
Search	Search File Name	Search File Description	Search File Date & Time	Search Classification	Search Size
13380	Thesis_Final.pdf	-	2015-03-23 13:18:24	-	4377.04
13381	Milton Madison Chemistry.PDF	Milton Madison Tensiles and Chemistry.PDF	2015-03-23 13:19:09	-	79.24

Go to Page 1

273 total entries

First Previous 1 Next Last



Structural Engineering

How?

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 - **Information** that describes *what, when, where, who?*
 - **File collections** that can be *explored*
 - **Parameters** that surface important data and make them *searchable*

Parameters

```
317      NKA-MF-  
0021420000000004500000Mirage  
Flats Canal      Lembke Rd  
Approx 16 miles  
southwest9999000511700000000000  
0042280379102521880007302690919  
9002000000502010500500000000050  
0000000000A151010000020000999000  
49000107000000005000509990N0000  
N0000006646N232723274NN48738100  
0000031224N  N  N  
0522000000000522002010  0  0  
0N3 00000018001501Y800000082030  
NY  
1 06251
```

NBI ASCII Files


NBI Record Format

With the conversion to metric and the addition of new items it is required to expand the size of the NBI record to 432 characters. The following format will be use to submit data to the FHWA.








ITEM NO	ITEM NAME	ITEM POSITION	ITEM LENGTH/TYPE
1	State Code	1 - 3	3/N
8	Structure Number	4 - 18	15/AN
5	Inventory Route	19 - 27	9/AN
5A	Record Type	19	1/AN
5B	Route Signing Prefix	20	1/N
5C	Designated Level of Service	21	1/N
5D	Route Number	22 - 26	5/AN
5E	Directional Suffix	27	1/N

Nebraska Bridges, 2014


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[Maps](#)

Use search boxes above columns to filter data 

Show **10** entries First Previous **1** 2 3 4 5 ... 20 Next Last Search:

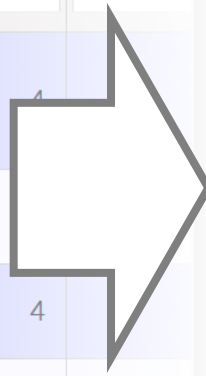
Id	Title	Experiment or Case ID	Keywords	Report(s)	Parameters	Data	Photos, Videos, etc
<input type="text" value="Search Id"/>	<input type="text" value="Search Title"/>	<input type="text" value="Search Experiment"/>	<input type="text" value="Search Keywords"/>	<input type="text" value="Search Report(s)"/>	<input type="text" value="Search Parameters"/>	<input type="text" value="Search Data"/>	<input type="text" value="Search Photos, Videos, etc"/>
333333540	Sundown Road at THIRTY-TWO MILE CREEK	C000103430	Concrete continuous Slab	-	NBI Parameters 	-	-
333333444	IRR BIA RTE 805 at OWL CREEK	00000000000B309	Steel Stringer/Multi-beam or Girder	-	NBI Parameters 	-	-
333333445	IRR BIA RTE 820 at FOX CREEK	00000000000B312	Concrete continuous Culvert (includes frame substructure)	-	NBI Parameters 	-	-
333333446	IRR BIA RTE 820 at COON CREEK	00000000000B313	Concrete continuous Culvert (includes frame substructure)	-	NBI Parameters 	-	-
333333447	IRR BIA RTE 815 at ROYS CREEK	00000000000B314	Prestressed concrete continuous* Stringer/Multi-beam or Girder	-	NBI Parameters 	-	-
333333448	IRR BIA RTE 820 at DEER CREEK	00000000000B315	Concrete continuous Culvert (includes frame substructure)	-	NBI Parameters 	-	-
333333449	IRR BIA RTE 809 at FOX CREEK	00000000000B316	Concrete continuous Culvert (includes frame substructure)	-	NBI Parameters 	-	-
333333484	COUNTY ROAD at LITTLE BLUE RIVER	C000101705	Steel Truss - Thru	-	NBI Parameters 	-	-

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[Clear Filters](#)
[No-Wrap](#)

Use search boxes above columns to filter data 

Show **10** entries
 First
Previous
1
2
3
4
5
...
20
Next
Last
Search:

Id	Title	Experiment or Case ID	1: State Code	8: Structure Number	5A: Record Type	5B: Route Signing Prefix	5C: Des
<input type="text" value="Search Id"/>	<input type="text" value="Search Title"/>	<input type="text" value="Search Experi"/>	<input type="text" value="Search 1: State"/>	<input type="text" value="Search 8: Structure Num"/>	<input type="text" value="Search 5A: Record"/>	<input type="text" value="Search 5B: Route Signing P"/>	<input type="text" value="Search 5C: Des"/>
333333401	Lembke Rd at Mirage Flats Canal	NKA-MF-002	317	NKA-MF-002	1		
333333402	470 Lane at Mirage Flats Canal	NKA-MF-010	317	NKA-MF-010	1		
333333403	County Road 720 at Red Willow Canal	NKA-RW-002	317	NKA-RW-002	1	4	
333333404	COUNTY RECREATIONA at MEDICINE CREEK DAM SPILL	NKA-FCD-001	317	NKA-FCD-001	1	4	
333333405	COUNTY ROAD 44B at TRENTON DAM SPILLWAY	NKA-FCD-002	317	NKA-FCD-002	1	4	
333333406	STATE HIGHWAY 61 at ENDERS SPILLWAY	NKA-FCD-003	317	NKA-FCD-003	1		3
333333407	South Rd 828 at Mirdan Canal	NKA-MIR-001	317	NKA-MIR-001	1		4
333333408	Field Access at Cambridge Canal	NKA-CAMB-001	317	NKA-CAMB-001	1		8
		NKA-CAMB					



Sort average daily traffic: descending

29: Average Daily Traffic	32: Approach Roadway Width	33: Bridge Median	34: Skew	35: Structure Flared
3940	1410204000400100000	PAWNEE		
3925	W. 12TH STREET	6290 W.		
2500	12TH STREET	999900175260		
2000	4035494909828110600330202071935020000	3940	201120	
1715	0850000000050000000000A151010000010000086000670			
1715	00073000000008600869999N0000N0000005556N0254018			
1500	154N568341000073091224N N N			
1350	0000660000060000992012 0 0		0N2	
	00195016000001Y300	3940	20330000NN	
	0 04920	?		
	2011	2	91	45
	2012	5	79	0
	2011	5	73	0

29: Average Daily Traffic
Average daily traffic (ADT) volume for the identified route. Most recent ADT counts available, including trucks counted in ADTT.

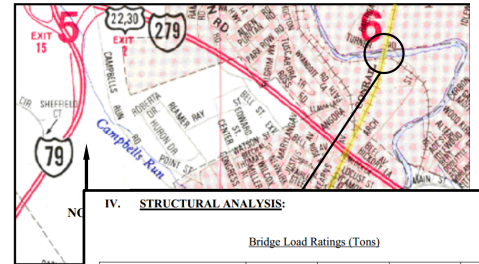


Filter to show only steel bridges

Files

VERTICAL LIFT BRIDGE	Federal Agency	SR	Material	Construction Type	Report(s)	Data	Photos, Videos, etc.	Drawings/Diagrams
VERTICAL LIFT BRIDGE	Search Federal Agency	Search SR	steel	Search Construction Type	317C000104105P			
0	NN	600	Steel continuous	Stringer/Multi-beam or Girder	1410217500400100000LITTLE BLUE RIVER S. SHOWBOAT BLVD. 13075 S. SHOWBOAT BLVD. 999900237060			
0	NN	603	Steel	Stringer/Multi-beam or Girder	402524000982036000063020207196602000010302011501100000000050000000000A1540200000			
0	NN	1000	Steel continuous	Stringer/Multi-beam or Girder	3000007400338000863005005007400889999N000N0000006576N1390123654N588			
0	NN	1000	Steel	Culvert (includes frame culverts)	000000101224N N N			
0	NN	195	Steel	Girder and Floorbeam System	00000000000000000002012 0 0			
0	NN	645	Steel	Stringer/Multi-beam or Girder	0N2 00000011000001Y500076020330000NN0 06000			
0	NY	341	Steel	Girder and Floorbeam System	-	-	-	-
0	NN	970	Steel	Stringer/Multi-beam or	-	-	-	-

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 0021420000000004500000Mirage
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 000000A1510100000200009990004900
 0107000000005000509990N0000N0000
 006646N232723274NN48738100000003
 1224N N N
 0522000000000522002010 0 0
 0N3 00000018001501Y800000082030
 NY
 1 06251



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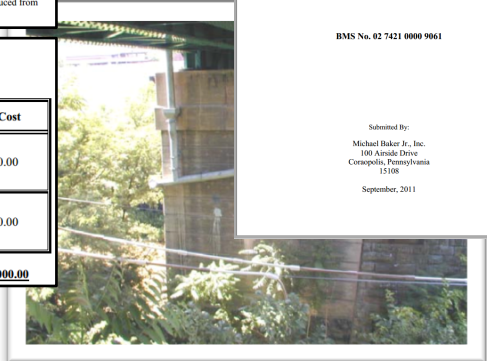
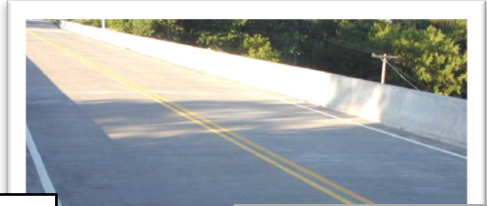
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Creating

1. Define cases

(one-at-a-time or using spreadsheets)

2. Upload files

(in-browser or server)

3. Define parameters

(using spreadsheets)

An Alternative

Remote site: /db/nees/NEES-2010-0904.groups/Experiment-10/Documentation/.Generated_Pics

- NEES-2010-0904.groups
 - .Generated_Pics
 - Documentation
 - Experiment-1
 - Experiment-10
 - Documentation
 - .Generated_Pics
 - Public
 - Specimen-3283
 - Trial-1
 - Rep-1
 - Converted_Data
 - Corrected_Data
 - Derived_Data
 - Unprocessed_Data
 - Experiment-11
 - Documentation
 - Public
 - Specimen-3284
 - Trial-1
 - Experiment-2
 - Experiment-3

Filename	Filesize	Filetype	Last modifi...	Permissi...	Owr
..					
display_1674161_Overall.png	42,068	PNG File	2014-12-09...	-rwxrwx-...	www
display_1674162_Reinforcement.png	69,563	PNG File	2014-12-09...	-rwxrwx-...	www
display_1674163_Strain Gages.png	60,014	PNG File	2014-12-09...	-rwxrwx-...	www
display_1674164_Test Setup.png	88,839	PNG File	2014-12-09...	-rwxrwx-...	www
thumb_1674161_Overall.png	2,865	PNG File	2014-12-09...	-rwxrwx-...	www
thumb_1674162_Reinforcement.png	4,269	PNG File	2014-12-09...	-rwxrwx-...	www
thumb_1674163_Strain Gages.png	3,907	PNG File	2014-12-09...	-rwxrwx-...	www

- **Organized** differently from owner-to-owner
- Files for each bridge are **disconnected** from parameters
- Exploration & sharing is **more difficult**

DataHub can help you

- **Organize** your bridge health data
- **Annotate** file collections from bridge inspections and **connect** them to the parameters that describe the bridges
- **Explore** and **share** the data easily

