Median Drains Hydraulic Policy

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What are Median Drains?

The drainage infrastructure required for areas that separate opposing lanes of traffic or divided roadways that contain trapped flow.

What are Median Drains?

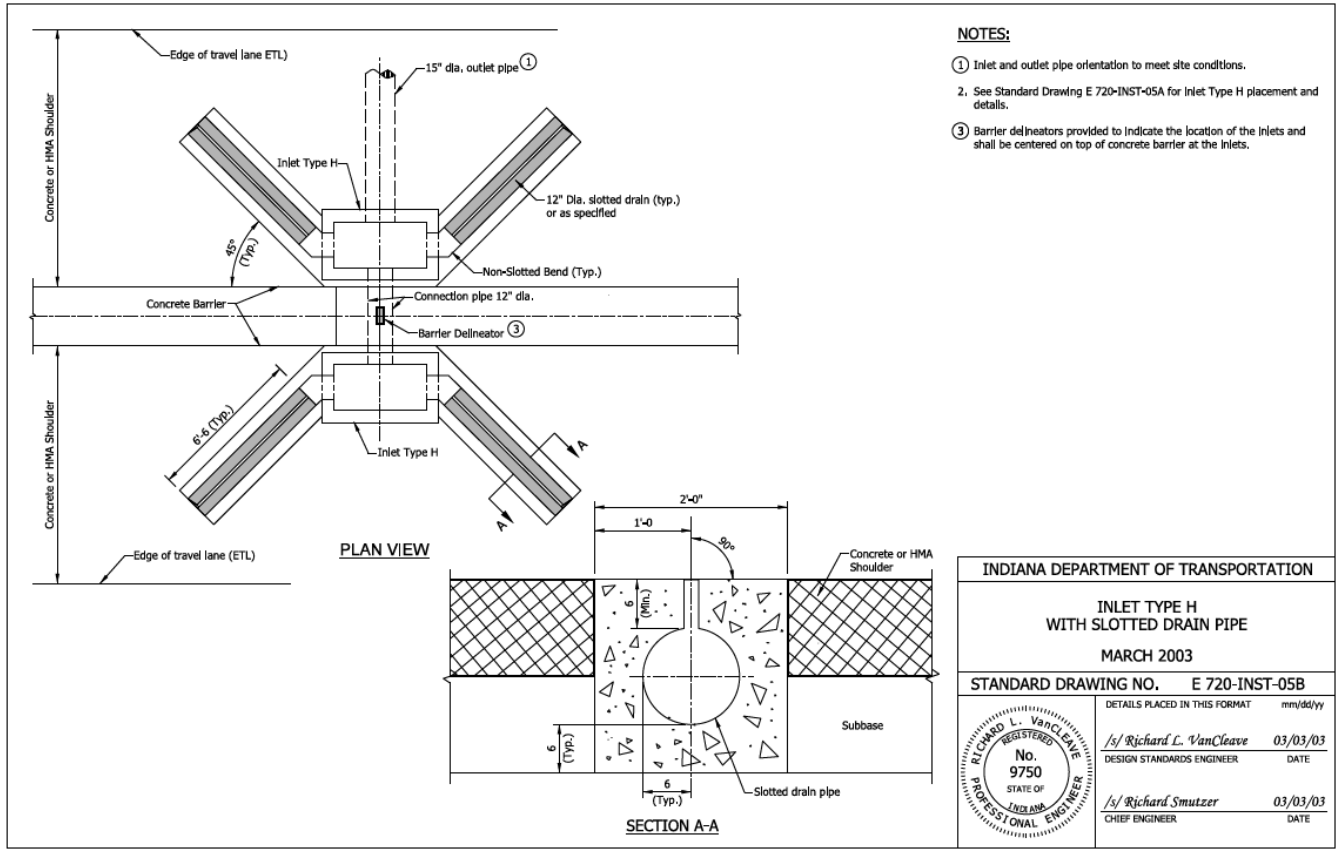
Shoulder Areas with Barrier Walls

- Generally use a H-5 or HA-5 type inlet due to flatter slopes (less than 10:1)
- Concrete or HMA Shoulders
- Spacing usually close

What are Median Drains?

Shoulder Areas with Barrier Walls

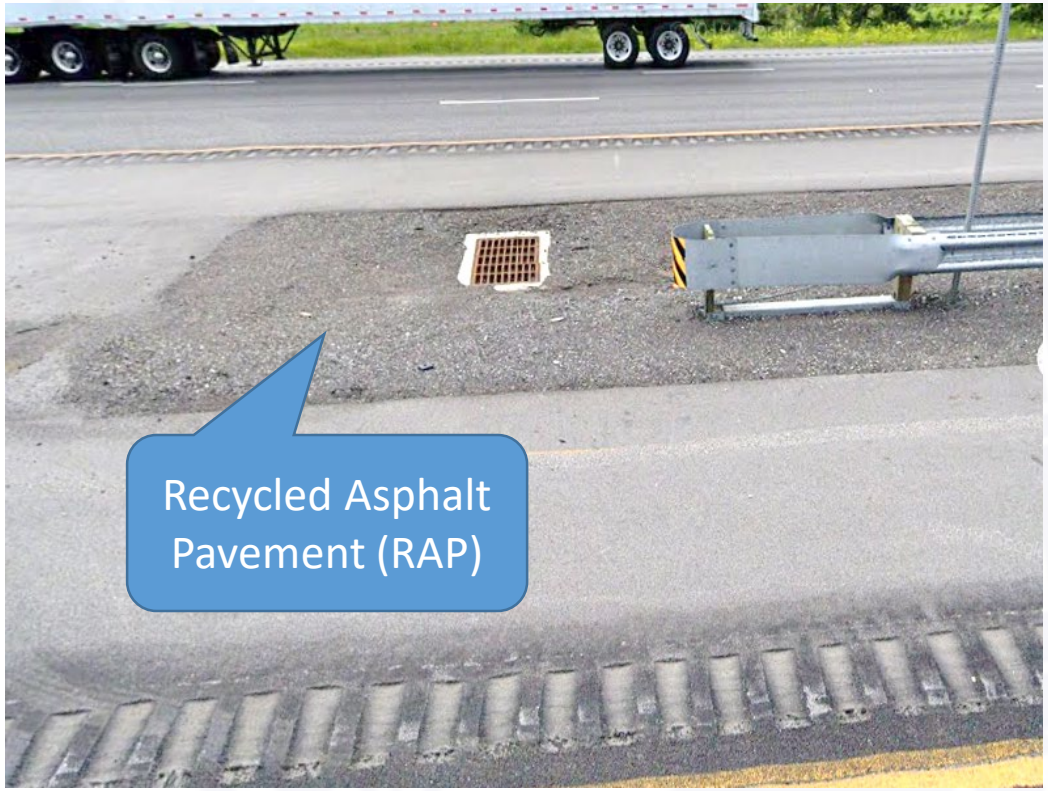
- May have slotted drain option (mainly for snow melt against barrier wall)
- Slotted drain option should be used in sags, low side of superelevated curves and every third inlet on grade (IDM 203-4.04(10))



What are Median Drains?

Non-Wall Divided Areas

- Most Common: Recycled Ashphalt Pavement (RAP) or Vegetated
- Will use a P-12 or N-12 type



Type P-12 Inlet

Type N-12 Inlet

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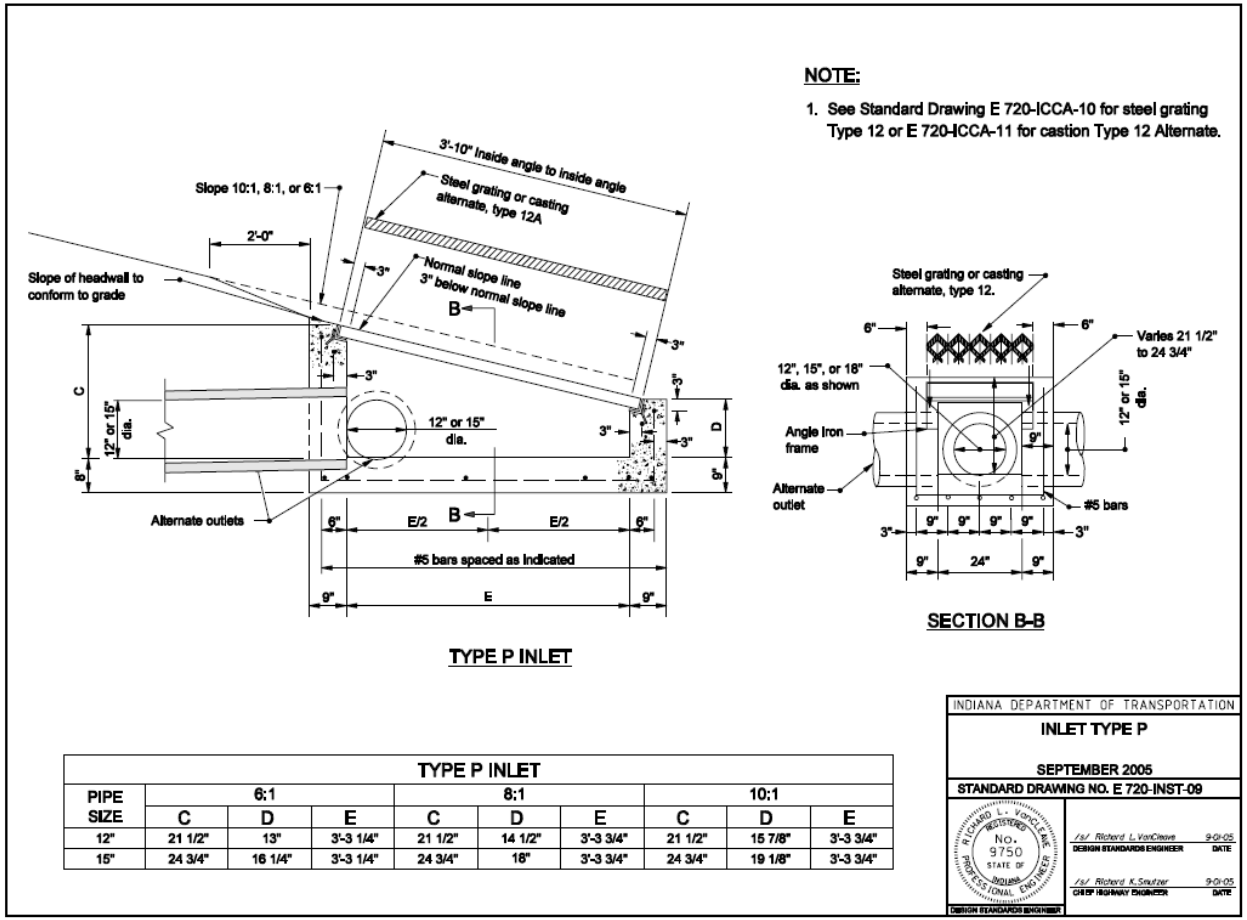
What are Median Drains?

Non-Wall Divided Areas

- P-12 and N-12 type inlet has adjustable slope (6:1, 8:1, 10:1)
- The basin can be modified deeper to accommodate larger pipe



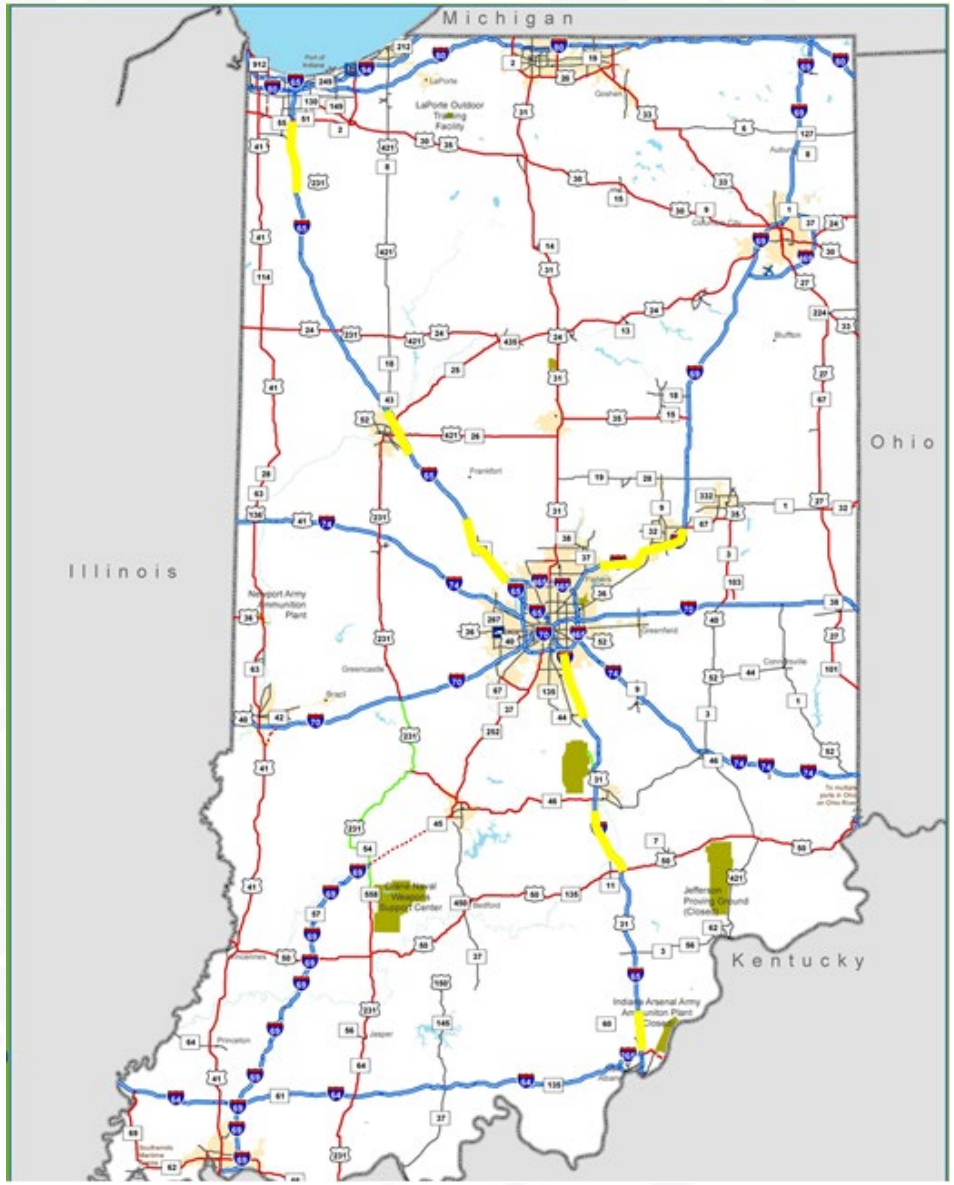
TYPE P INLET

PIPE SIZE	6:1			8:1			10:1		
	C	D	E	C	D	E	C	D	E
12"	21 1/2"	13"	3'-3 1/4"	21 1/2"	14 1/2"	3'-3 3/4"	21 1/2"	15 7/8"	3'-3 3/4"
15"	24 3/4"	16 1/4"	3'-3 1/4"	24 3/4"	16"	3'-3 3/4"	24 3/4"	19 1/8"	3'-3 3/4"

Statewide Interstate Added Travel Lanes (ATL)

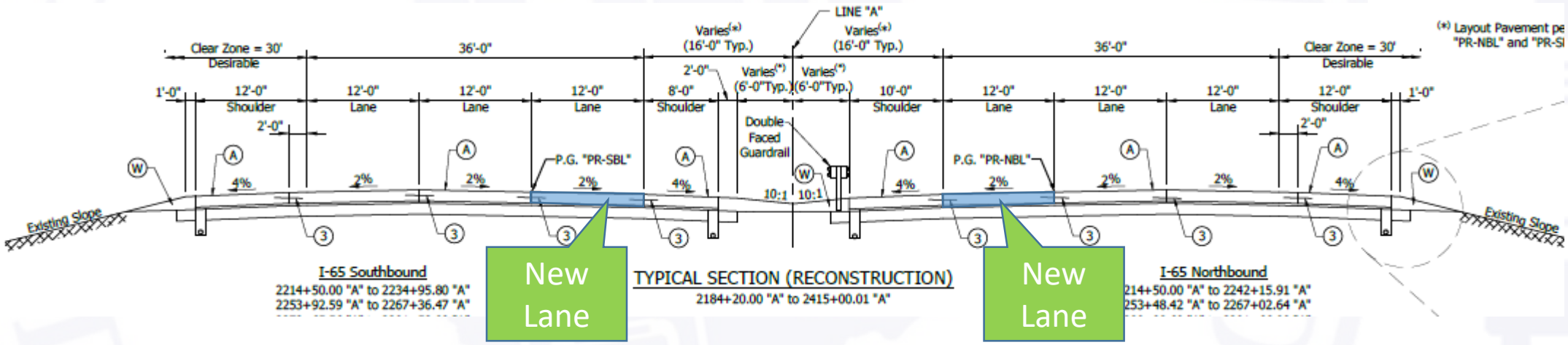
Recently completed or in progress

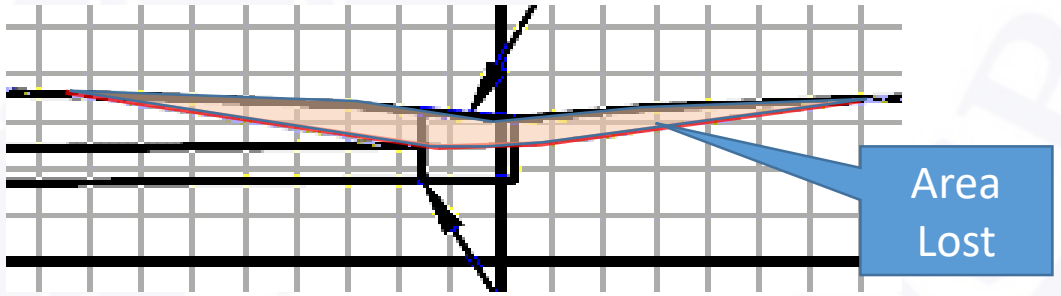
- Mostly I-65 & I-69



Statewide Interstate Added Travel Lanes

- Added lanes encroach into the existing median
  - Median loses waterway conveyance area
  - Inside edge of travel lane becomes a lower elevation (2% x 12 ft = 0.24 ft)





Statewide Interstate Added Travel Lanes

- Added lanes encroach into the existing median

Median Drain Risks

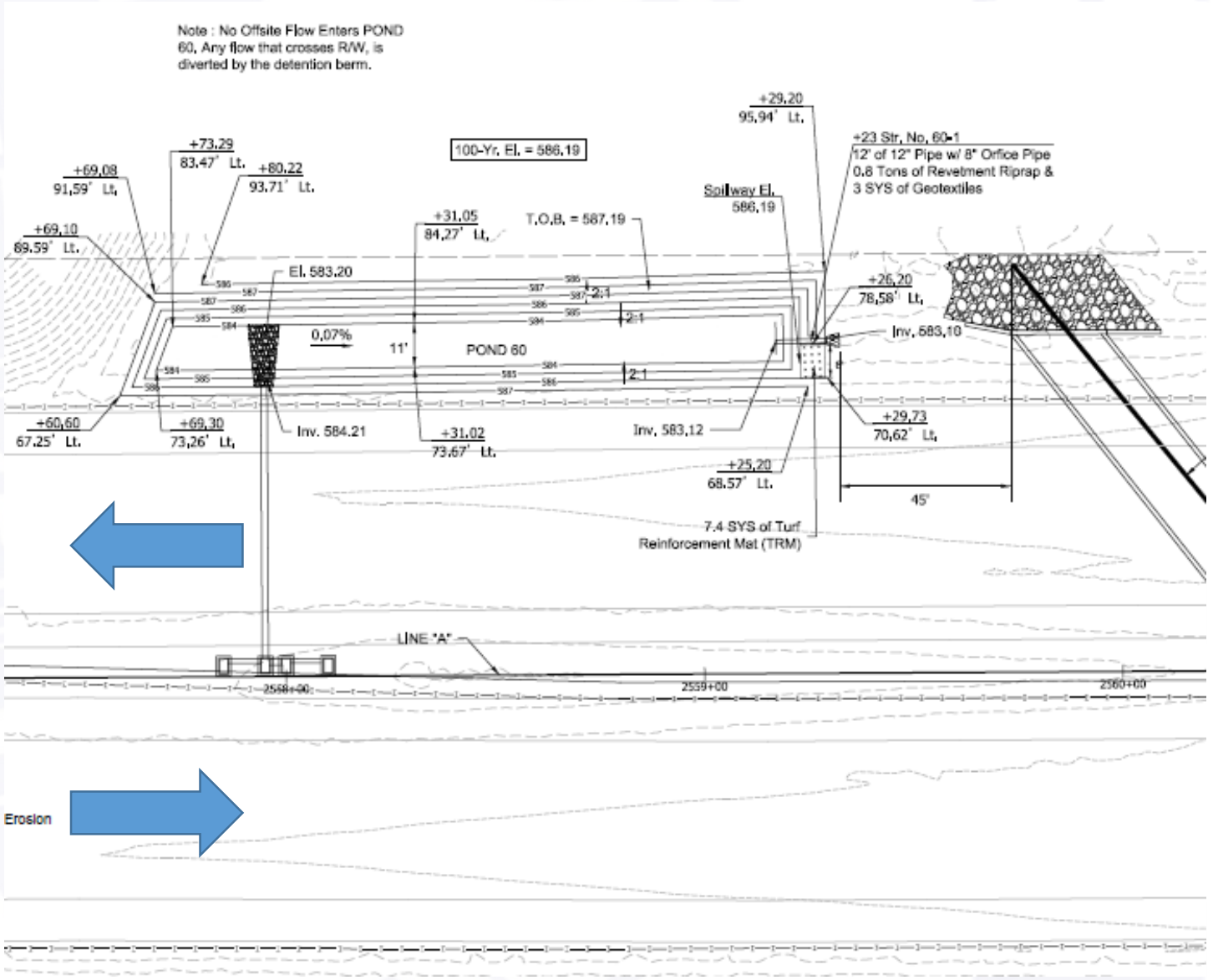
- Lack of Redundancy
  - Water will go on or over the roadway if drainage fails
  - The road is the emergency spillway
  - Medians are typically on major corridors and/or divided highways
    - High Traffic Volume (traffic delays, commute times increase)
    - High Travel Speeds (safety)
    - Economy (commerce affected)

Median Drain Risks

- Clogging
  - Flatter inlets at higher risk of clogging
  - Higher traffic volume = more trash
  - Grass clippings from mowers in vegetated medians
  - Leaves from nearby forests

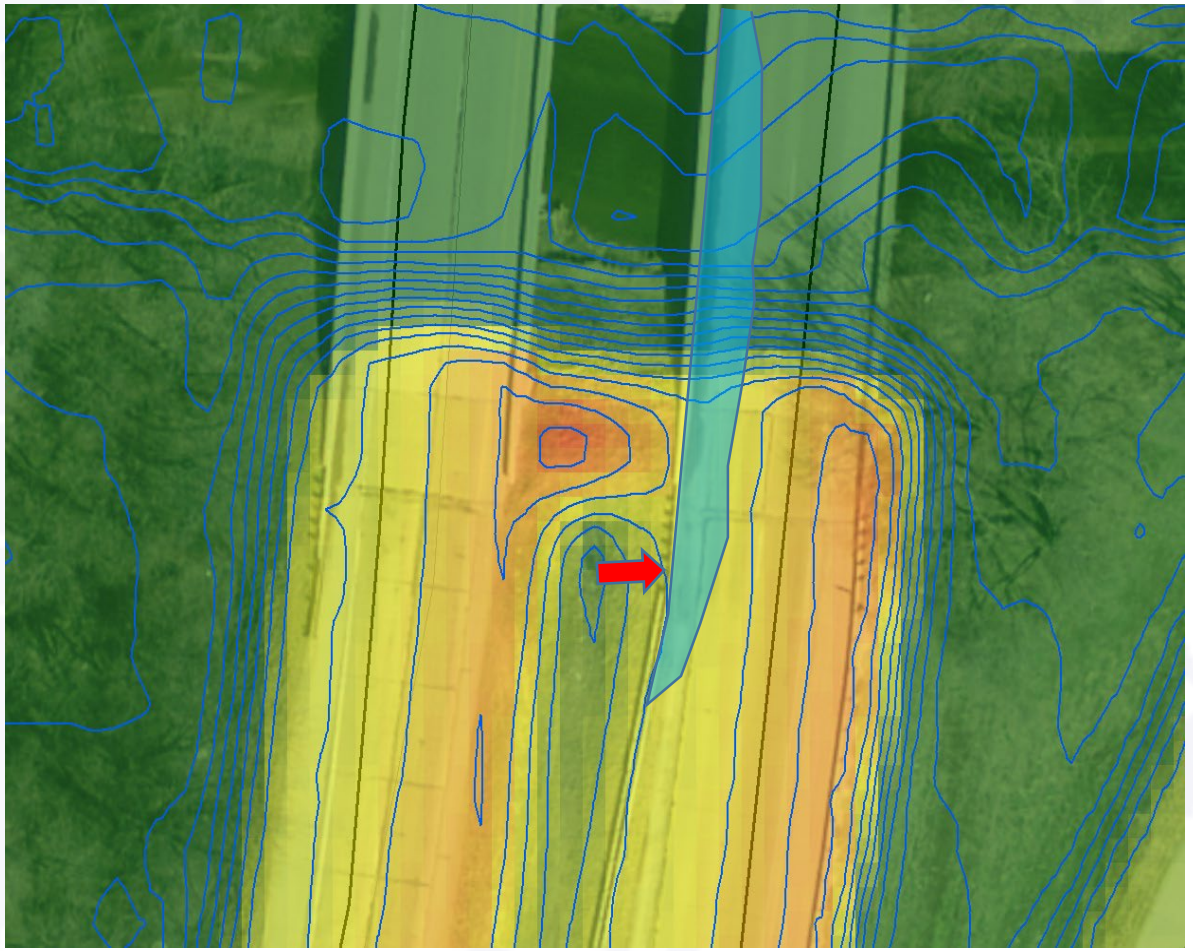
Median Drain Risks

- High Tailwater Conditions
  - Side ditch conveyance
  - Bridge or culvert headwater backup
  - Detention Ponds



Median Drain Risks

- Berms that are higher than roadways

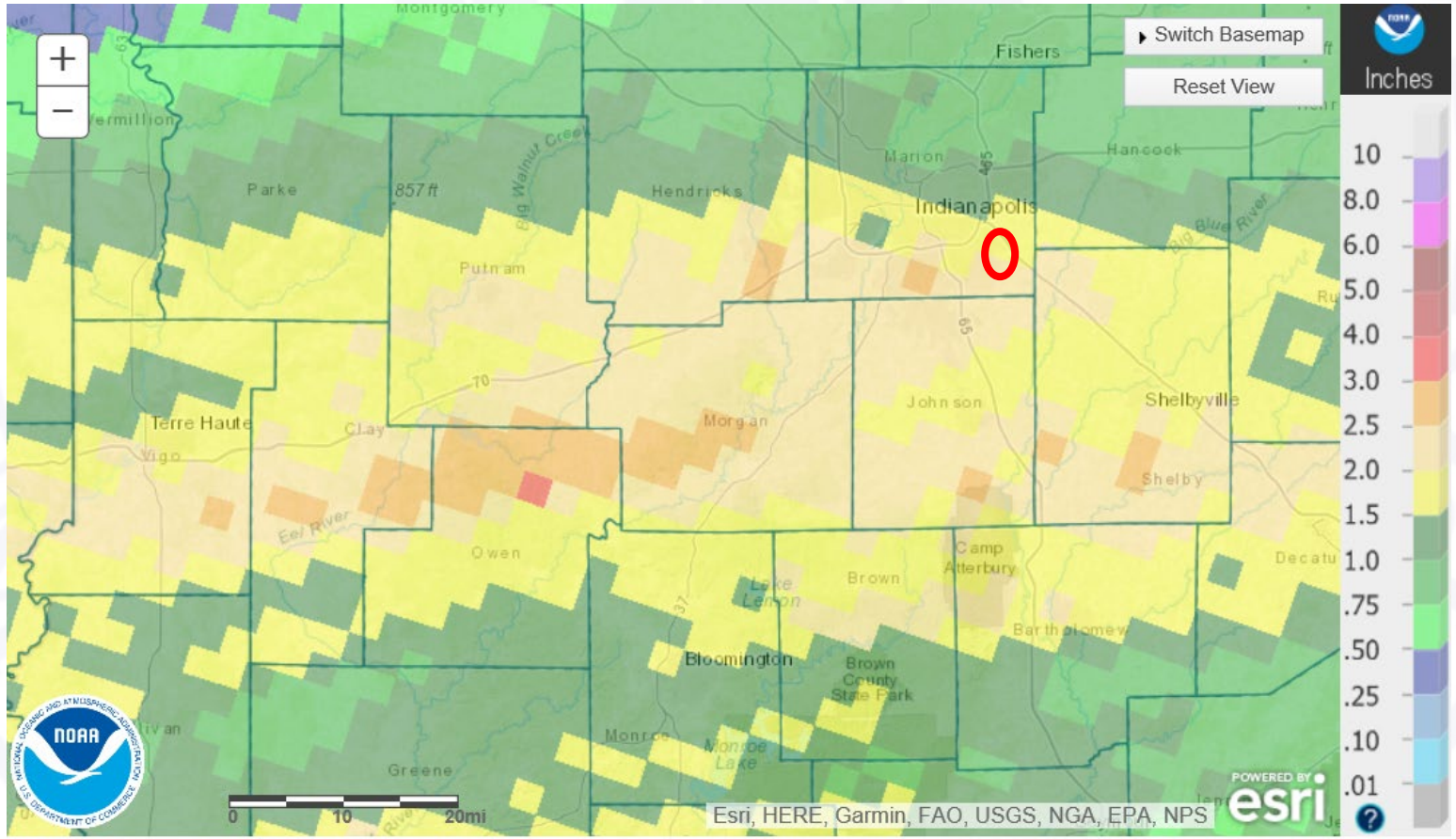


Median Drain Risks

- Poor Design
  - Discharge determination too low
  - Inlet location
  - Lack of consideration of the risks
  - Not following policy or considering other precautions
  - Not maintainable

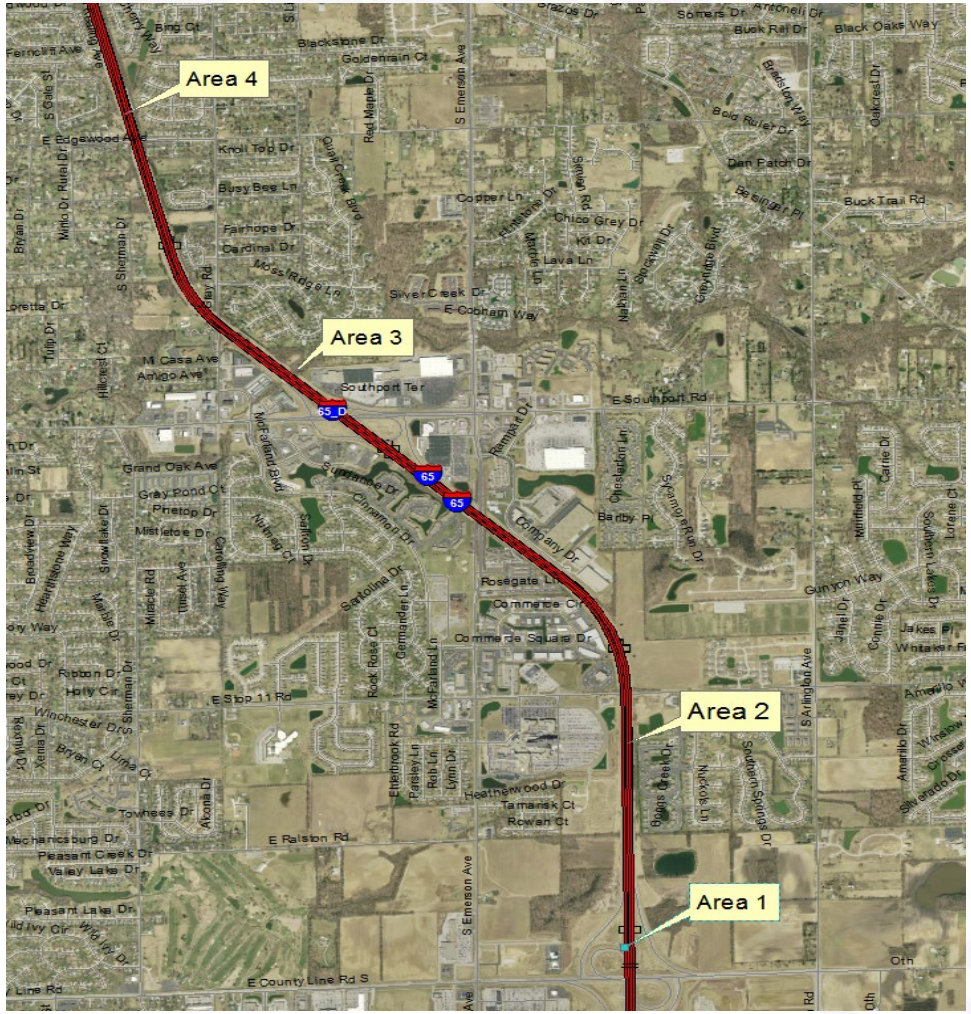
I-65 South Indy Example

- Local Flooding on April 3, 2018, closes I-65 on the Indy Southside for approximately 3-6 hours initiated by heavy rains during the Tuesday morning commute.
- Note: I-65 added travel lane construction was 2014-2015.



I-65 South Indy Example

- After some time, INDOT Hydraulics called out to investigate. Four major areas found.

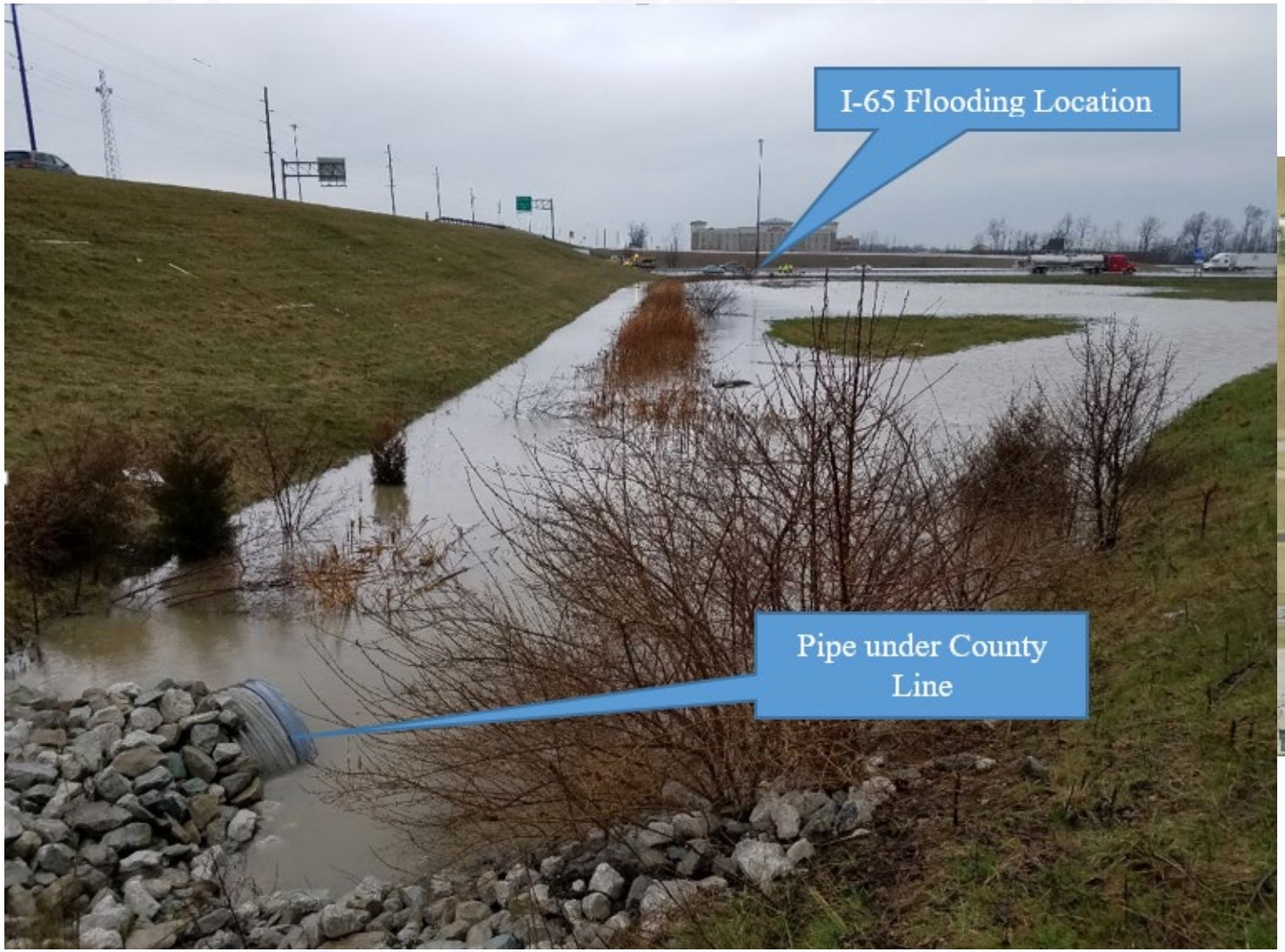


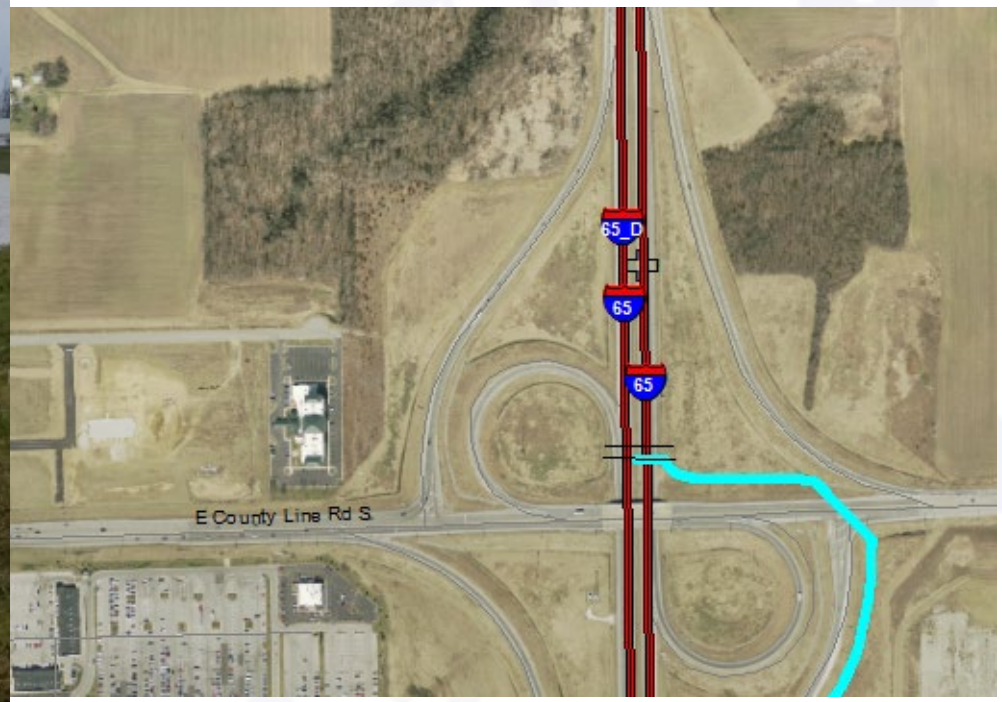
I-65 South Indy Example – AREA 1

- INDOT pumping to the northeast interchange infield at County Line Rd
- Water must have been subsiding since debris was out into the travel lanes

I-65 South Indy Example – AREA 1

- Pipe under County Line Road potentially backing up into northeast infield and median





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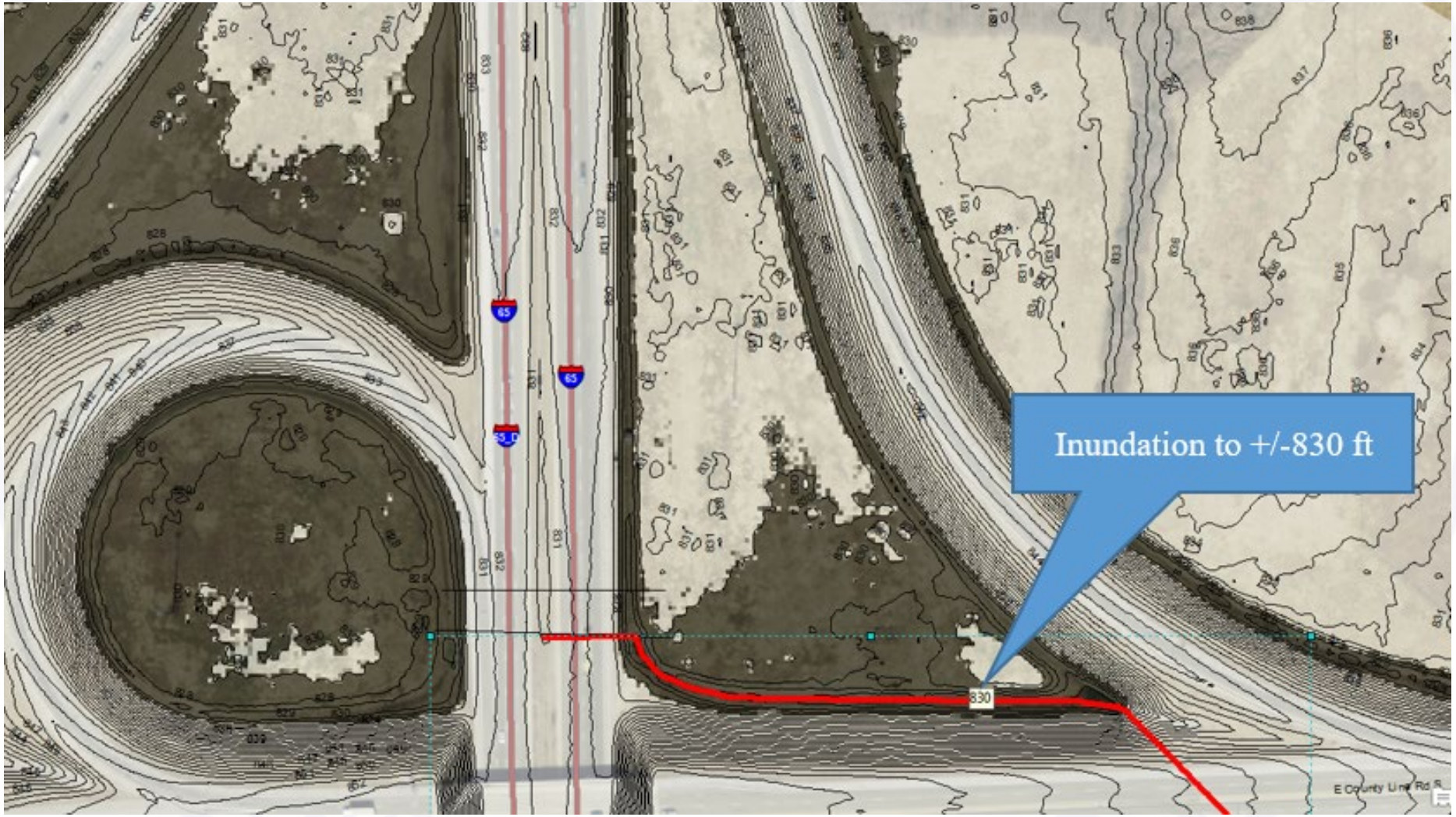
I-65 South Indy Example – AREA 1

- At arrival, infield water elevation approximately 830 feet. Higher prior.
- Median Casting Elevation 830.5 feet. Edge of road around 831-832 feet.



I-65 South Indy Example – AREA 1

Possible Causes

- Tailwater channel downstream of culvert was flat, restricted and heavily vegetated.
- Culvert capacity
- Median pipe inverts too low for high tailwater conditions
- Clogging (inlet was submerged and couldn’t be seen)
- No flanking inlets in the sag for redundancy
- Snow melt the day before

I-65 South Indy Example – AREA 2

- Between County Line Road & Southport Road
- Multiple sag areas, small drainage areas
- Flooded, but not into lanes – Where did all the grass come from?

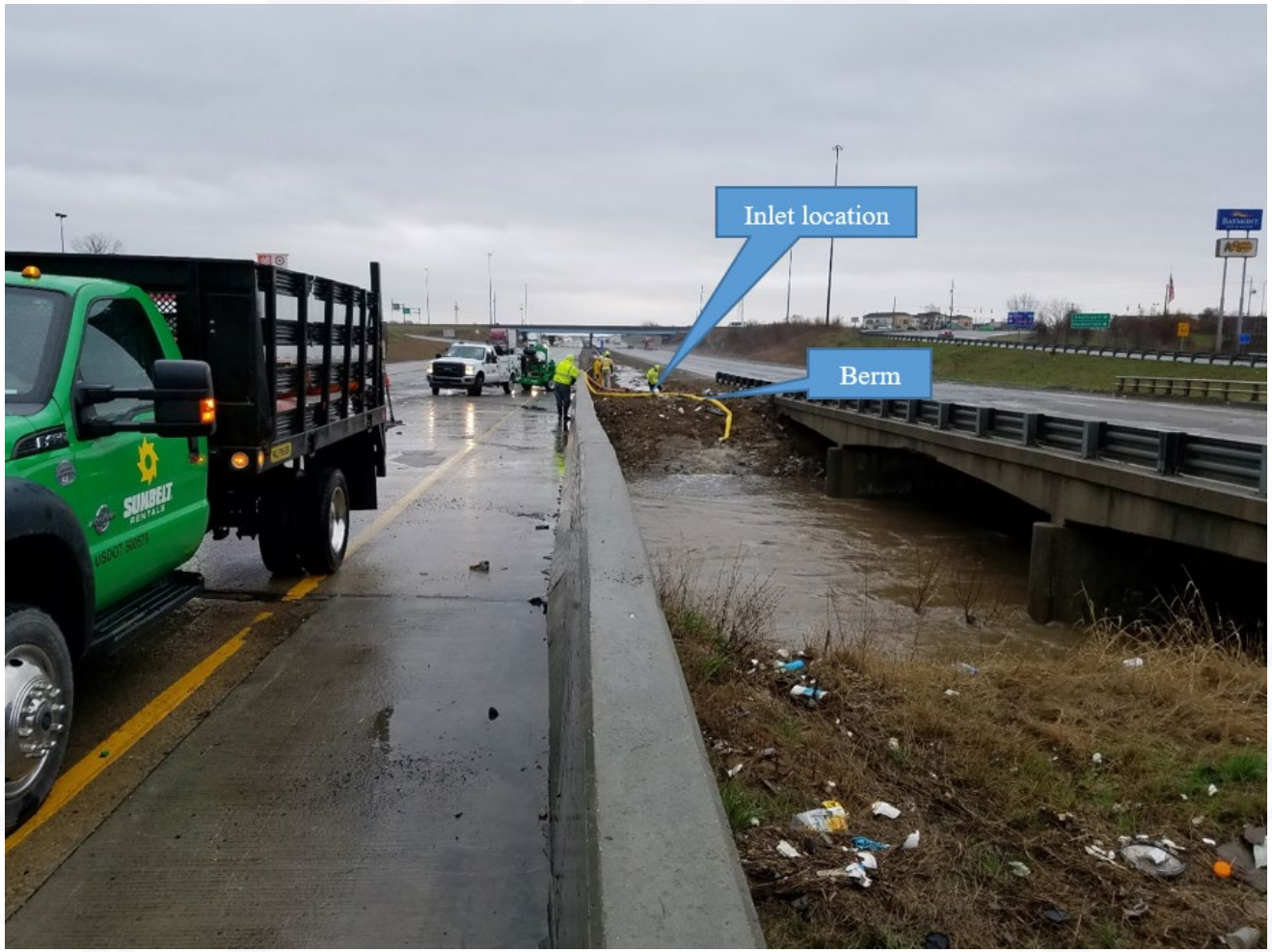
I-65 South Indy Example – AREA 2

Possible Causes

- Clogging
- No flanking inlets in the sags for redundancy
- In one location there were dual inlets (pre-construction), now a single inlet

I-65 South Indy Example – AREA 3

- Just north of Southport Road at Little Buck Creek
- Inlet submerged, berm (higher than road) at the creek
- Was flooded into travel lanes before arrival



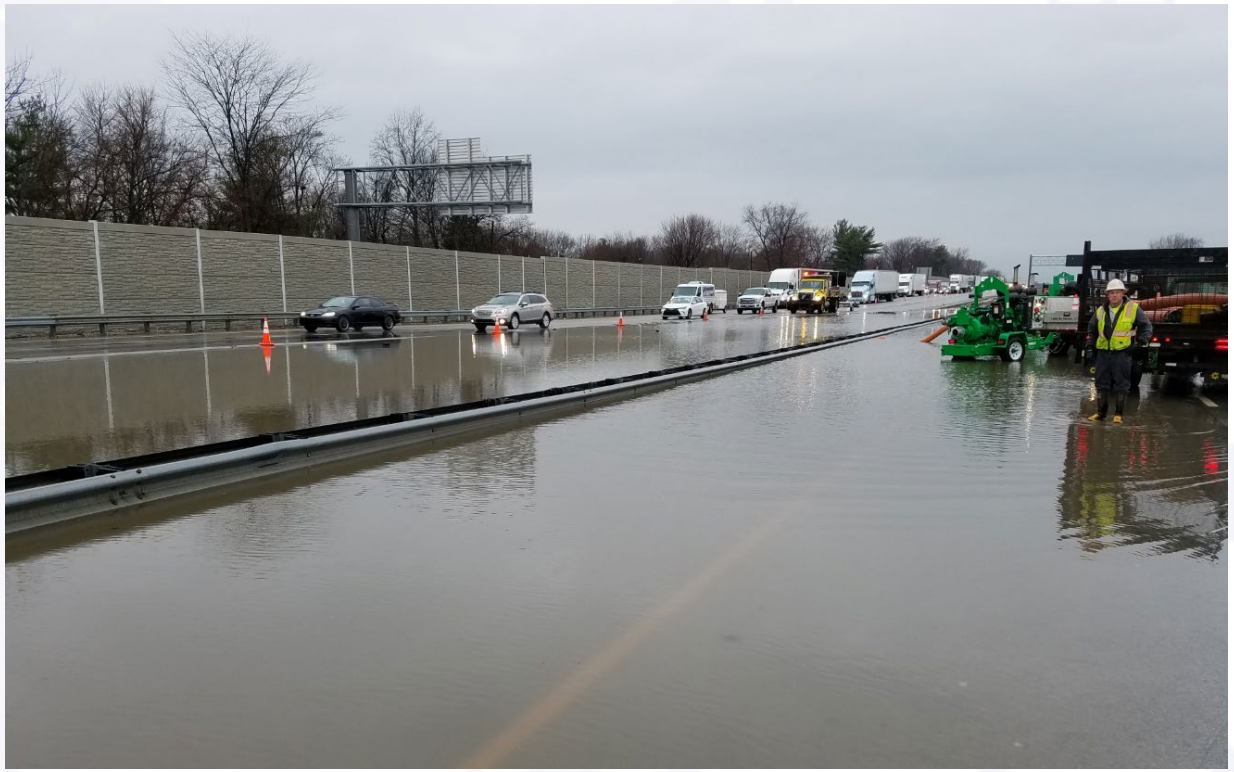
I-65 South Indy Example – AREA 3

Possible Causes

- Long stretch of drainage area, high discharge if at grade inlets are clogged
- Main inlet not found, either submerged, clogged, or under riprap
- Berm higher than road, flow couldn’t get into the creek
- Flow had to go into the roadway instead
- No flanking inlet for redundancy
- Possibly high tailwater condition

I-65 South Indy Example – AREA 4

- Between Southport Road and I-465 (Near Edgewood Ave)
- Inlet submerged
- Was flooded across most of the travel lanes (overtopping the road crown)



I-65 South Indy Example – AREA 4

- Maintenance crews started pumping water – with limited results
- INDOT Hydraulics found sag inlet after searching in water for 30 minutes
- After somewhat unclogging, water level started dropping immediately

I-65 South Indy Example – AREA 4

- Most of the water was gone within 10 minutes
- Even a N-12 inlet can clog

I-65 South Indy Example – AREA 4

- Google Street View June 2019

I-65 South Indy Example – AREA 4

Possible Causes

- Long stretch of drainage area (0.8 miles long)
- Clogging
- No flanking inlet for redundancy

I-65 South Indy Example – AREA 4

- Near area #4, Downstream of Median to Median pipe
- Trash debris trapped within the outlet grate

I-65 South Indy Example – Recommendations

All Areas

- Routine maintenance to clean debris
- Provide flanking inlets to improve redundancy

Area 1

- Enlarge downstream ditch capacity and bore a new pipe under County Line Road

Area 3

- Lower ditch berm below road shoulder elevation

I-65 South Indy Example – Applications

INDOT Road Cleaning Program

- INDOT has started contracting out trash and litter pickup
- INDOT crews still pickup trash as well
- In Fall 2018, 2339 40-gallon bags of trash were filled along Marion County interstates with 749 man hours
- In April 2019, 3825 40-gallon bags were filled on I-64 and 4170 bags were filled on I-69 from Monroe to Vanderburgh County

I-65 South Indy Example

Storm Event

- Snowmelt the day before
- 2.6 inches recorded at airport
- 2-3 inches per radar estimate
- Estimated 3-6 hour storm duration (per Weather Underground)

Appears to be 5 to 10-year storm event
(per NOAA Atlas 14)

PDS-based precipitation frequency estimates with 90% cont

Duration	Average recurrence interval (years)					
	1	2	5	10	25	50
5-min	0.376 (0.336-0.424)	0.448 (0.399-0.504)	0.536 (0.477-0.603)	0.606 (0.538-0.681)	0.697 (0.614-0.785)	0.768 (0.672-0.867)
10-min	0.584 (0.522-0.659)	0.699 (0.623-0.787)	0.833 (0.742-0.938)	0.936 (0.830-1.05)	1.07 (0.939-1.20)	1.16 (1.02-1.31)
15-min	0.716 (0.639-0.808)	0.855 (0.762-0.963)	1.02 (0.911-1.15)	1.15 (1.02-1.29)	1.32 (1.16-1.48)	1.44 (1.26-1.63)
30-min	0.948 (0.846-1.07)	1.14 (1.02-1.29)	1.40 (1.25-1.58)	1.60 (1.42-1.80)	1.86 (1.64-2.09)	2.06 (1.80-2.33)
60-min	1.16 (1.03-1.31)	1.40 (1.25-1.58)	1.76 (1.57-1.98)	2.03 (1.80-2.29)	2.41 (2.12-2.72)	2.71 (2.37-3.06)
2-hr	1.35 (1.21-1.53)	1.64 (1.46-1.85)	2.06 (1.84-2.32)	2.40 (2.13-2.70)	2.87 (2.53-3.22)	3.26 (2.85-3.66)
3-hr	1.43 (1.29-1.62)	1.74 (1.55-1.96)	2.19 (1.95-2.47)	2.55 (2.27-2.87)	3.07 (2.70-3.45)	3.50 (3.05-3.93)
6-hr	1.70 (1.52-1.93)	2.06 (1.84-2.33)	2.60 (2.32-2.93)	3.04 (2.69-3.42)	3.67 (3.22-4.12)	4.20 (3.65-4.71)

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INDOT Median Drain Policy

GUIDANCE

- INDOT has very limited hydraulic guidance for median drains in the Indiana Design Manual (IDM)
- INDOT has learned from previous added travel lane (ATL) projects
- The following guidance is mostly based on the most recent ATL project technical provisions
- IDM to be updated with median drain policy in the near future

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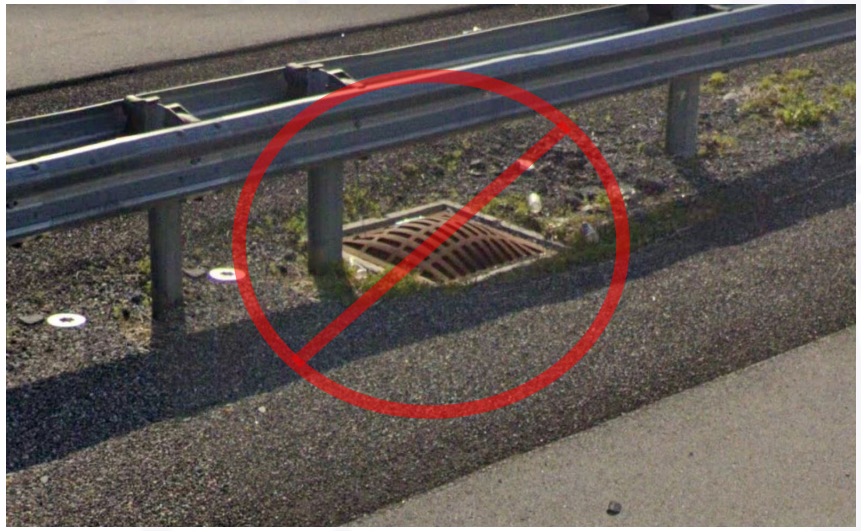
INDOT Median Drain Policy

Use P-12 inlets (IDM 203-4.04(12))

- Recommend using N-12 inlets if at all possible, to fit within the design footprint



E-7 Inlet
3.4 sq.ft.
NOT ALLOWED

P-12 Inlet
5.1 sq.ft.
ALLOWED

N-12 Inlet
10.2 sq.ft.
MOST DESIRABLE

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INDOT Median Drain Policy

Inlet Spacing and HGL calculations (from recent ATL technical provisions)

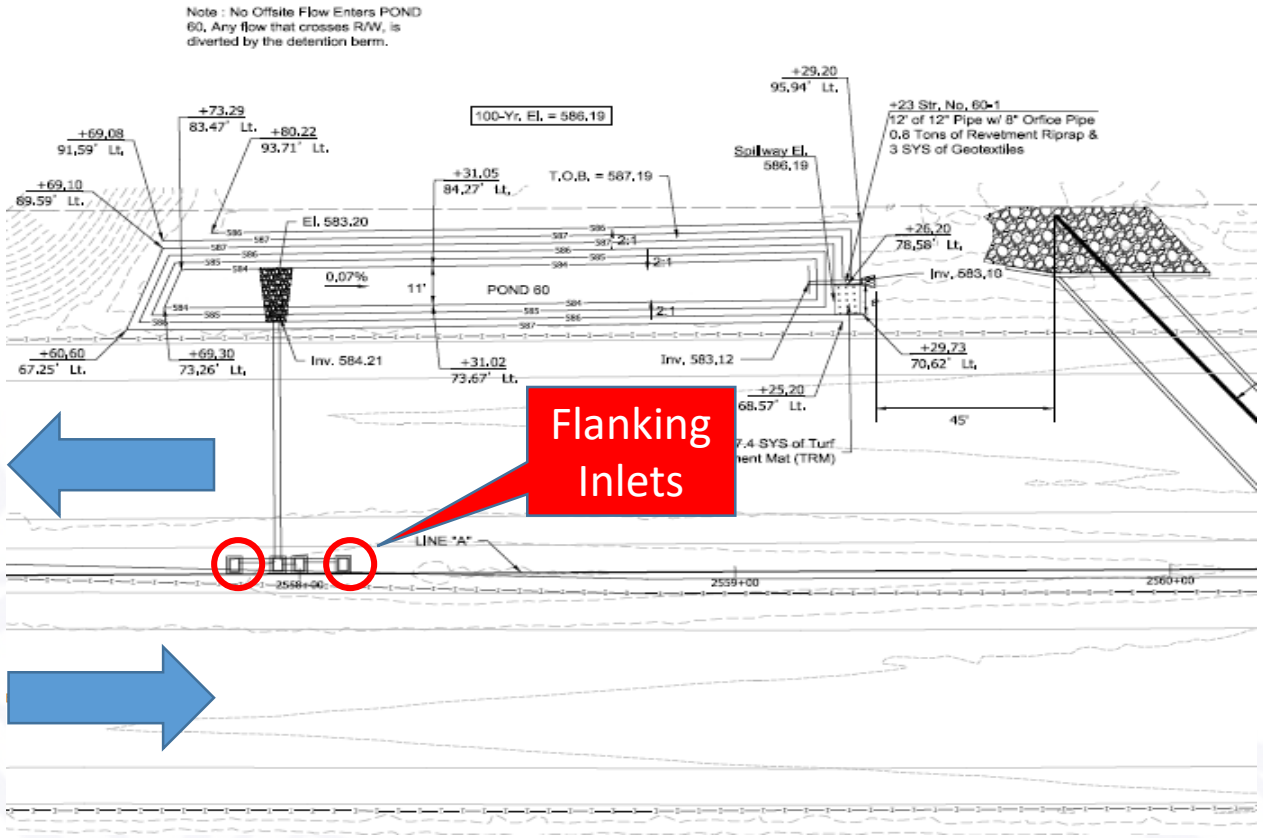
- Use 50-year storm event
  - For median ditch spread
  - For HGL check on median inlet and pipe capacity
- Should not encroach into travel lanes
  (0 freeboard allowed for median but more is desired)
  - Provide some freeboard when possible
  - Example upgrade a 15” pipe to 18” for some redundancy if near 0 freeboard
- No stormwater detention allowed in the median ditches

NextLevel INDIANA

INDOT Median Drain Policy

Flanking Inlets Required at all Sags

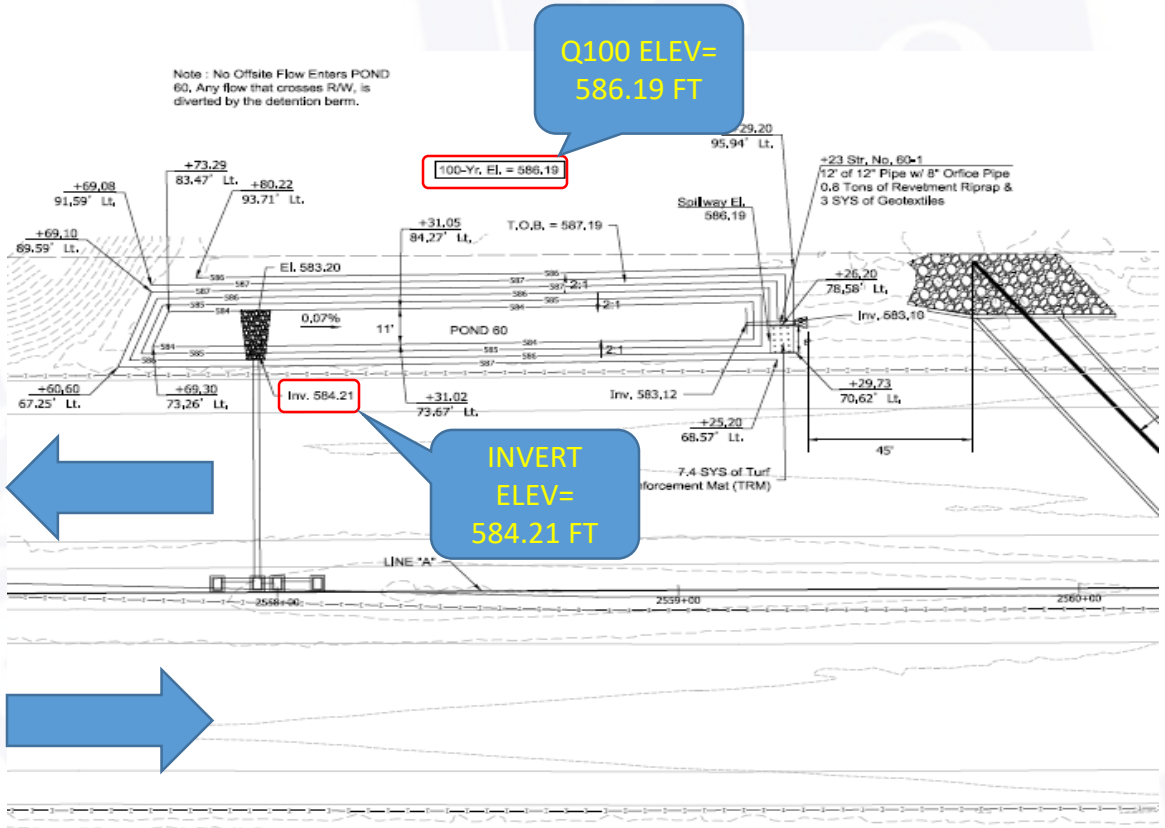
- Should be set below low sag edge of travel lane
- For one direction flow to sag, one flanker inlet is sufficient



INDOT Median Drain Policy

For outlet into a pond, near a culvert/bridge or the side ditch is part of a defined creek/stream

- Check to see if median pipe outlet invert will be below Q100 Elevation
- If so, check HGL (with appropriate tailwater depth) to make sure it is not above Edge of Travel Lanes



EXAMPLE:
Since Q100 Elev > Median Invert Elev, additional HGL check required

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INDOT Median Drain Policy

For outlet into typical side ditch

- If median pipe outlet invert is set 1.0 feet above ditch flowline or higher
  - No further action required
- If median pipe outlet invert is set 0.5 feet to 1.0 feet above ditch flowline
  - HGL check required with appropriate side ditch water elevation
- Median pipe outlet invert less than 0.5 feet above ditch flowline – NOT ALLOWED

INDOT Median Drain Policy

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INDOT Median Drain Policy

Runoff Coefficient “C” for Rational Method

- Pavement
  - No less than 0.90
- Recycled Asphalt Pavement (RAP) or compacted No. 53 Stone
  - No less than 0.80

Manning’s Channel Roughness “n” Value

- Pavement
  - Minimal 0.012
- Recycled Asphalt Pavement (RAP) or compacted No. 53 Stone
  - Minimal 0.025

INDOT Median Drain Policy

Include a spreadsheet to compare elevations - show HGL, ETL, Rim, Inverts, Tailwater Elev, Flowline Elev, Pipe size

STATION	LOCATION	STR. NO.		PIPE LENGTH (ft)	PIPE INFO								Tailwater Elev.	Flowline Elev.	Q DESIGN (cfs)	Hydraulic Grade Line Elev.		Rim Elev.	Edge of Travel Lane Elev.	HGL < ETL Y/N	Outlet Velocity (fps)
					DIAMETER		SLOPE (%)	n	INVERT		CROWN										
		Up	Down		(in)	(ft)			Up	Down	Up	Down				Up HGL_i	Down HGL_o				
Median Outlets																					
2414+85	Med. Rt.	455	OUT	69	15	1.25	0.77	0.012	594.17	593.64	595.42	594.89	594.89	572.93	5.82	***595.90***	***594.89***	596.67	597.64	Y	5.69
2435+00	Med. Lt.	456	OUT	70	15	1.25	0.94	0.012	581.66	581.00	582.91	582.25	582.25	574.37	6.72	***583.67***	***582.25***	584.15	585.10	Y	6.30
2439+23	Med. Lt.	458	OUT	73	18	1.50	1.85	0.012	580.81	579.46	582.31	580.96	580.96	571.08	10.57	***583.21***	***580.96***	583.23	584.12	Y	9.43
2442+00	Med. Lt.	461	OUT	73	15	1.25	1.55	0.012	581.30	580.17	582.55	581.42	581.42	574.81	5.98	***583.07***	***581.42***	583.79	584.46	Y	5.76
2446+50	Med. Lt.	462	OUT	71	15	1.25	1.66	0.012	582.19	581.01	583.44	582.26	582.26	573.89	5.98	***583.96***	***582.26***	584.68	585.37	Y	5.76
2450+00	Med. Lt.	463	OUT	71	15	1.25	1.52	0.012	582.90	581.82	584.15	583.07	583.07	572.41	5.98	***584.67***	***583.07***	585.39	586.11	Y	5.76
2454+00	Med. Lt.	464	OUT	71	15	1.25	1.51	0.012	583.68	582.61	584.93	583.86	583.86	572.98	5.98	***585.45***	***583.86***	586.18	586.99	Y	5.76
2458+00	Med. Lt.	465	OUT	69	15	1.25	1.51	0.012	584.47	583.43	585.72	584.68	584.68	572.64	6.47	***586.40***	***584.68***	586.96	587.84	Y	7.70
2466+30	Med. Lt.	466	OUT	72	15	1.25	1.88	0.012	585.97	584.62	587.22	585.87	585.87	574.63	5.90	***587.71***	***585.87***	588.47	589.45	Y	5.72
2470+00	Med. Lt.	468	OUT	73	15	1.25	0.79	0.012	586.69	586.11	587.94	587.36	587.36	574.45	5.24	***588.25***	***587.36***	589.20	590.18	Y	5.70
2481+30	Med. Lt.	470	OUT	81	15	1.25	1.54	0.012	586.71	585.46	587.96	586.71	586.71	574.75	5.49	***588.34***	***586.71***	589.11	590.19	Y	5.52
2488+00	Med. Lt.	471	OUT	92	15	1.25	1.71	0.012	584.24	582.67	585.49	583.92	583.92	579.86	6.39	***586.14***	***583.92***	586.75	587.74	Y	5.98
2491+80	Med. Rt.	473	OUT	85	15	1.25	1.69	0.012	582.86	581.42	584.11	582.67	582.67	579.81	6.88	***584.93***	***582.67***	585.19	586.18	Y	8.17
2496+72	Med. Lt.	476	OUT	77	18	1.50	0.74	0.012	580.63	580.06	582.13	581.56	581.56	579.00	9.67	***582.81***	***581.56***	583.38	584.30	Y	5.47
2499+00	Med. Rt.	478	OUT	117	15	1.25	1.71	0.012	581.93	579.93	583.18	581.18	581.18	577.31	6.80	***583.97***	***581.18***	584.26	585.16	Y	6.21
2503+50	Med. Lt.	479	OUT	82	15	1.25	1.71	0.012	588.58	587.18	589.83	588.43	588.43	578.57	6.80	***590.62***	***588.43***	591.09	592.08	Y	8.17
2508+00	Med. Lt.	480	OUT	83	15	1.25	1.64	0.012	600.63	599.27	601.88	600.52	600.52	581.41	6.47	***602.56***	***600.52***	603.12	604.02	Y	6.02
2520+00	Med. Lt.	481	OUT	71	15	1.25	1.82	0.012	600.45	599.16	601.70	600.41	600.41	579.99	6.55	***602.40***	***600.41***	602.96	603.95	Y	6.07
2524+80	Med. Lt.	483	OUT	69	15	1.25	1.51	0.012	588.74	587.70	589.99	588.95	588.95	579.15	7.46	***591.03***	***588.95***	591.25	592.24	Y	7.86
2530+04	Med. Lt.	485	OUT	77	15	1.25	1.75	0.012	583.74	582.39	584.99	583.64	583.64	580.78	8.68	***586.55***	***583.64***	586.52	587.42	Y	8.58

NextLevel INDIANA

THE END