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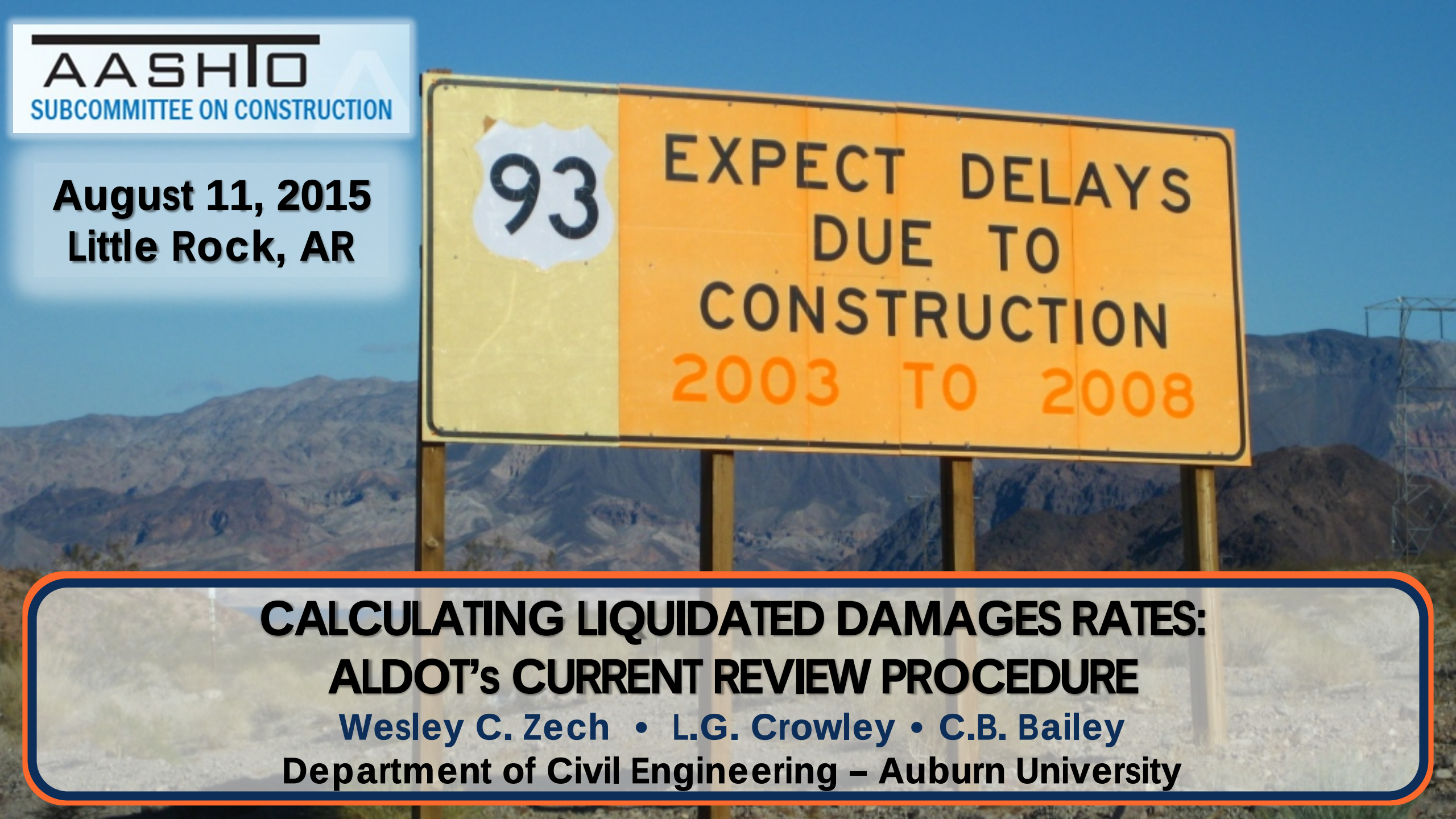
**August 11, 2015**
**Little Rock, AR**




# CALCULATING LIQUIDATED DAMAGES RATES: ALDOT's CURRENT REVIEW PROCEDURE

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# Liquidated Damages

**DEFINITION:** ***A daily monetary rate stipulated in a contract to compensate the owning agency for additional costs incurred as a result of a project extending beyond its completion date due to non-excusable delay***

**However, LDs are not:**

- **a penalty that is meant to persuade a contractor into timely completion of a project, or**
- **arbitrarily determined rates**

**LD rates must be:**

- **based on a reasonable forecast of actual damages and justifiable!**

# Federal Guidelines - 1987

- **23 CFR 635.127 defines LDs as:**

***"The daily amount set forth in the contract to be deducted from the contract price to cover <u>additional costs incurred by a state transportation department</u> because of contractor's failure to complete the contract work within the number of calendar days or workdays specified. The term may also mean total of all daily amounts deducted under the terms of a particular contract."***

- **States may develop rates:**
  - On a project specific basis, or
  - <u>In the form of a table or schedule of rate</u>

# Research Motivation

- ALDOT's previous provisions became outdated and experienced legal challenges regarding the Schedule of Liquidated Damages (LDs)
- Contractors challenged the schedule claiming that the rates were unenforceable, unjustifiable penalties
- ALDOT needed a method to determine LD rates that would:
  - withstand the scrutiny of the courts, and be
  - statistically justifiable

# Legal Aspect

- Courts generally test three criteria as proof of a valid LD (or I/D) clause:
  1. The sum stipulated is a reasonable pre-breach estimate of a probable loss
  2. The injury is difficult or impossible to accurately estimate (pre-breach)
  3. The parties intended to provide for damages rather than a penalty

Note: Camelot Music, Inc. v. Marx Realty & Improv. Co., Alabama, 1987

# Practical Issues w/LD Rate Development

- Three practical problems impact the development of LD's:
  1. Accuracy of historical record data used in formulating rates
  2. Time consumed in periodically reviewing and updated rates
  3. Soundness of the procedure used to calculate rates

- Project Objectives:
  1. Develop a robust methodology to produce a Schedule of LDs
  2. Compare current procedure vs. the proposed methodology
  3. Develop guidelines for reviewing/updating the Schedule of LDs

# Alabama Dept. of Transportation (2002)

- A simple average of "daily E&I costs" per contract value group was used
- Final LD rates were arranged in a table by contract value

**108.11 Schedule of Liquidated Damages.**

| Original Contract Amount | | Liquidated Damages Daily Charge | |
|---|---|---|---|
| More Than | To and Including | Calendar Day or Fixed Date | Work Day |
| $ 0 | $ 100,000 | $ 120 | $ 200 |
| 100,000 | 200,000 | 180 | 300 |
| 200,000 | 500,000 | 300 | 500 |
| 500,000 | 1,000,000 | 480 | 800 |
| 1,000,000 | 2,000,000 | 660 | 1,100 |
| 2,000,000 | 5,000,000 | 840 | 1,400 |
| 5,000,000 | 10,000,000 | 1,020 | 1,700 |
| 10,000,000 | - - - - - - | 1,200 | 2,000 |

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used.

Note: Per 2002 ALDOT Standard Specification

# ALDOT's Schedule of LDs (Dec. 2006)

- Elimination of outliers and redefining contract value groups was subjective

**108.11 Schedule of Liquidated Damages.**

| Original Contract Amount | | Liquidated Damages Daily Charge | |
|---|---|---|---|
| More Than | To and Including | Calendar Day or Fixed Date | Work Day |
| $ 0 | $ 500,000 | $ 250 | $ 500 |
| 500,000 | 1,000,000 | 500 | 1000 |
| 1,000,000 | 2,000,000 | 900 | 1800 |
| 2,000,000 | 5,000,000 | 1300 | 2600 |
| 5,000,000 | 10,000,000 | 1600 | 3200 |
| 10,000,000 | - - - - - | 1800 | 3600 |

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used.

Note: 2006 Schedule of Liquidated Damages became effective Dec. 1, 2006 per Special Provision No. 06-0304

# LD Calculation Procedure:
# Objectives of Methodology

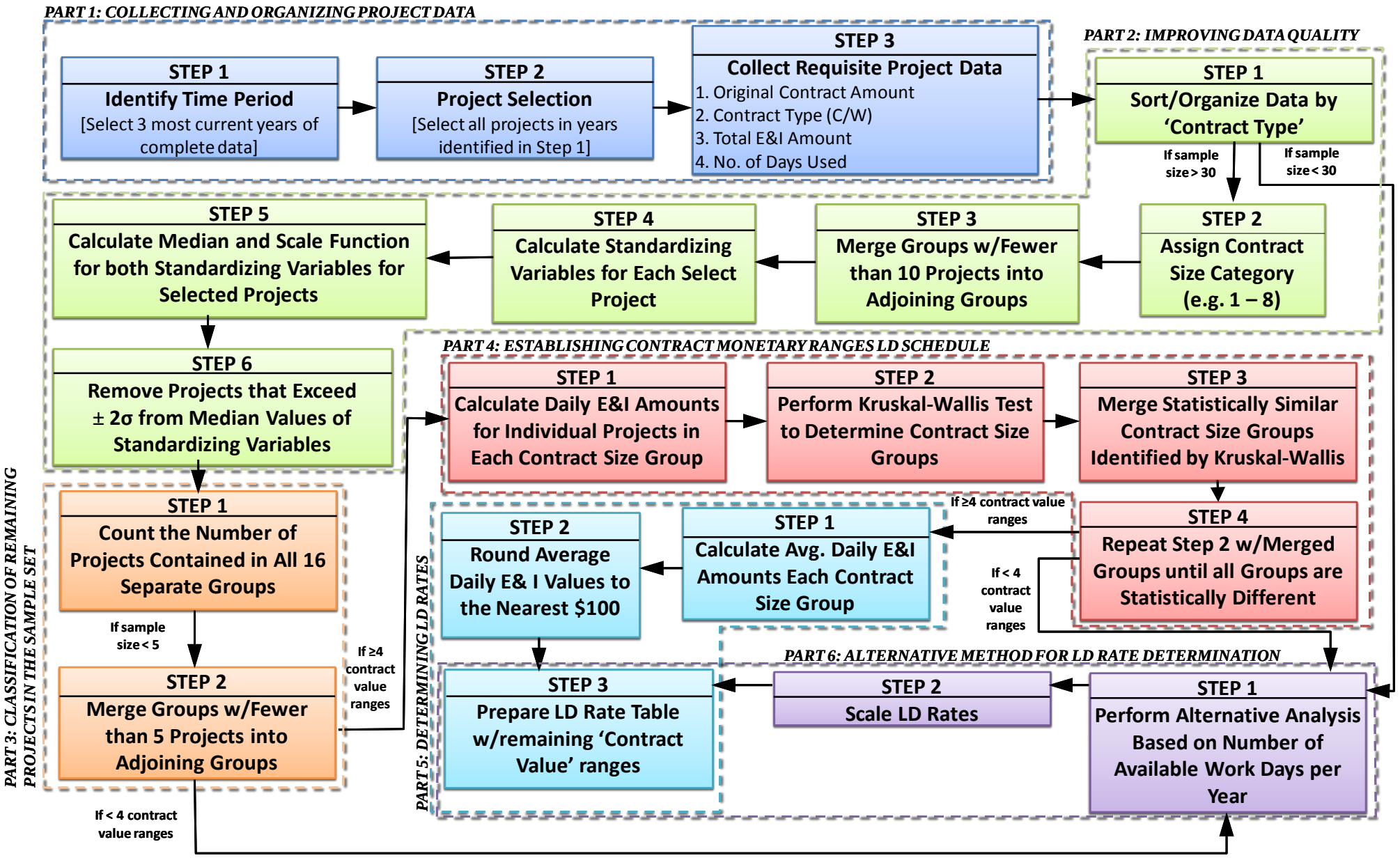
- Develop a methodology for determining LD rates and report values in a traditional schedule of damages

- Criteria:
  - Statistically justifiable
  - Lack subjectivity
  - Repeatable
  - Produce accurate LD rates
  - Ease of biennial procedure
  - Accepted by the courts

# LD Calculation Procedure: Stepwise Guidelines

- **Part 1**: Collecting and Organizing Project Data
- **Part 2**: Improving Data Quality (removing projects with atypical data values)
- **Part 3**: Classification of Remaining Projects in the Sample Set
- **Part 4**: Establishing Contract Monetary Ranges for LD Schedule
- **Part 5**: Determining Liquidated Damage (LD) Rates
- **Part 6**: Use Alternative Method due to Limited Sample Sizes

# Stepwise Procedural Flowchart



# LD Calculation Procedure: Data Collection and Analysis

- **Historical Project Data**
  - Three previous years (2003, 2004, 2005)
- **856 projects**
  - 726 Working Day projects (85%)
  - 129 Calendar Day projects (15%)
- **Collected Data**
  - Contract Value ($)
  - Contract Type (Cal. Day/Work Day)
  - Engineering & Inspection (E&I) costs
  - Number of days used to complete project
  - **Contract Size Group**

| Group | Contract Amount | |
|---|---|---|
| | From | To & Including |
| 1 | $0 | $100,000 |
| 2 | $100,000 | $200,000 |
| 3 | $200,000 | $500,000 |
| 4 | $500,000 | $1,000,000 |
| 5 | $1,000,000 | $2,000,000 |
| 6 | $2,000,000 | $5,000,000 |
| 7 | $5,000,000 | $10,000,000 |
| 8 | $10,000,000 | ---------- |

# LD Calculation Procedure: Calculating Daily E&I Values

- Compute daily E&I values for **individual** projects and organize by contract size groups:

$$Daily\ E\&I_j = \frac{E\&I\ Costs_j}{\#\ of\ Days\ Used_j}$$

- Need to eliminate **atypical** projects that were: (1) abnormal or (2) erroneous data
- Outlier analysis is performed based on two parameters:
  - E&I costs associated with individual projects, and
  - Number of days used to complete individual projects
- Not based on daily E&I because it is a calculated value

# LD Calculation Procedure: Outlier Analysis

- Based on two parameters
- Evaluation parameters are adjusted using the contract value:
  - E&I costs ➔ **E&I as a percentage of contract value**

$$\%E\&I = \frac{E\&I}{CV}$$

where,

*%EI* = E&I as a percent of contract value,

*E&I* = total E&I for the project, and

*CV* = original contract amount

  - Number of days used ➔ **contract dollars placed per day**

$$\$/day = \frac{CV}{d}$$

where,

*$/day* = dollars placed per day,

*d* = total number of days used for the project, and

*CV* = original contract value

# LD Calculation Procedure:
## Outlier Analysis (cont'd)

- Atypical projects were identified using the median values of selected parameters
  - ±2 SD's from the median based upon the **median absolute deviation (MAD)**
  - **MAD** is a scale estimate of the absolute differences between each individual observation

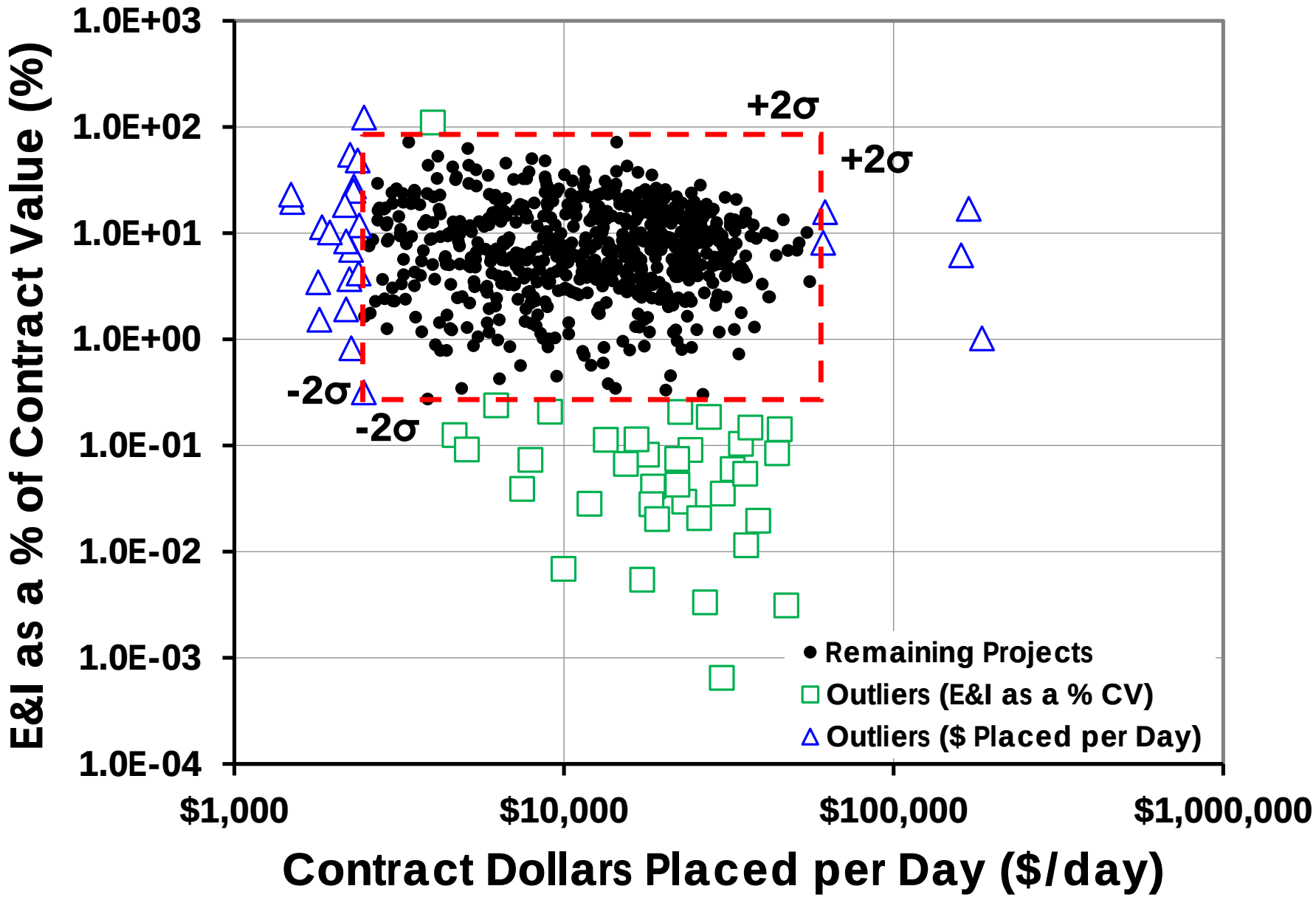
$$s_m = median\left(\frac{|x_i - M_d|}{0.6745}\right)$$

- Results of outlier analyses:

| GROUP | CV Range | No of Projects | |
|---|---|---|---|
| | | WD | CD |
| 1 | $0 - $100,000 | 18 | 1 |
| 2 | $100,000 - $200,000 | 47 | 14 |
| 3 | $200,000 - $500,000 | 167 | 29 |
| 4 | $500,000 - $1M | 207 | 20 |
| 5 | $1M - $2M | 103 | 9 |
| 6 | $2M - $5M | 34 | 11 |
| 7 | $5M - $10M | 21 | 8 |
| 8 | $10M and greater | 11 | 5 |
| **No. of Remaining Projects =** | | **608 (84%)** | **97 (75%)** |
| **No. of Outliers =** | | **118 (16%)** | **32 (25%)** |
| **Total No. of Projects =** | | **726 (100%)** | **129 (100%)** |

# LD Calculation Procedure:

## Outlier Analysis (cont'd)



# LD Calculation Procedure:

## Kruskal-Wallis Test

$$K = \frac{12\sum_{i=1}^{g} n_i \left( \frac{\sum_{j=1}^{n_g} \overline{r_{ij}}}{n_i} - \overline{r} \right)^2}{N(N+1)}$$

- Uses the daily E&I costs per project
- Rank–orders the data
- Compares the medians of groups
- Determines if a statistically significant difference exists [p-value = 0.05]

where,

$K$ = test statistic,
$n_g$ = number of observations in group $g$,
$r_{ij}$ = is the rank (among all observations) of observation $i$ from group $g$,
$r$ = average of all the observations, equal to $(N+1)/2$, and
$N$ = total number of observations across all groups

# LD Calculation Procedure:
# Work Day Results

**Contract Value Groups**

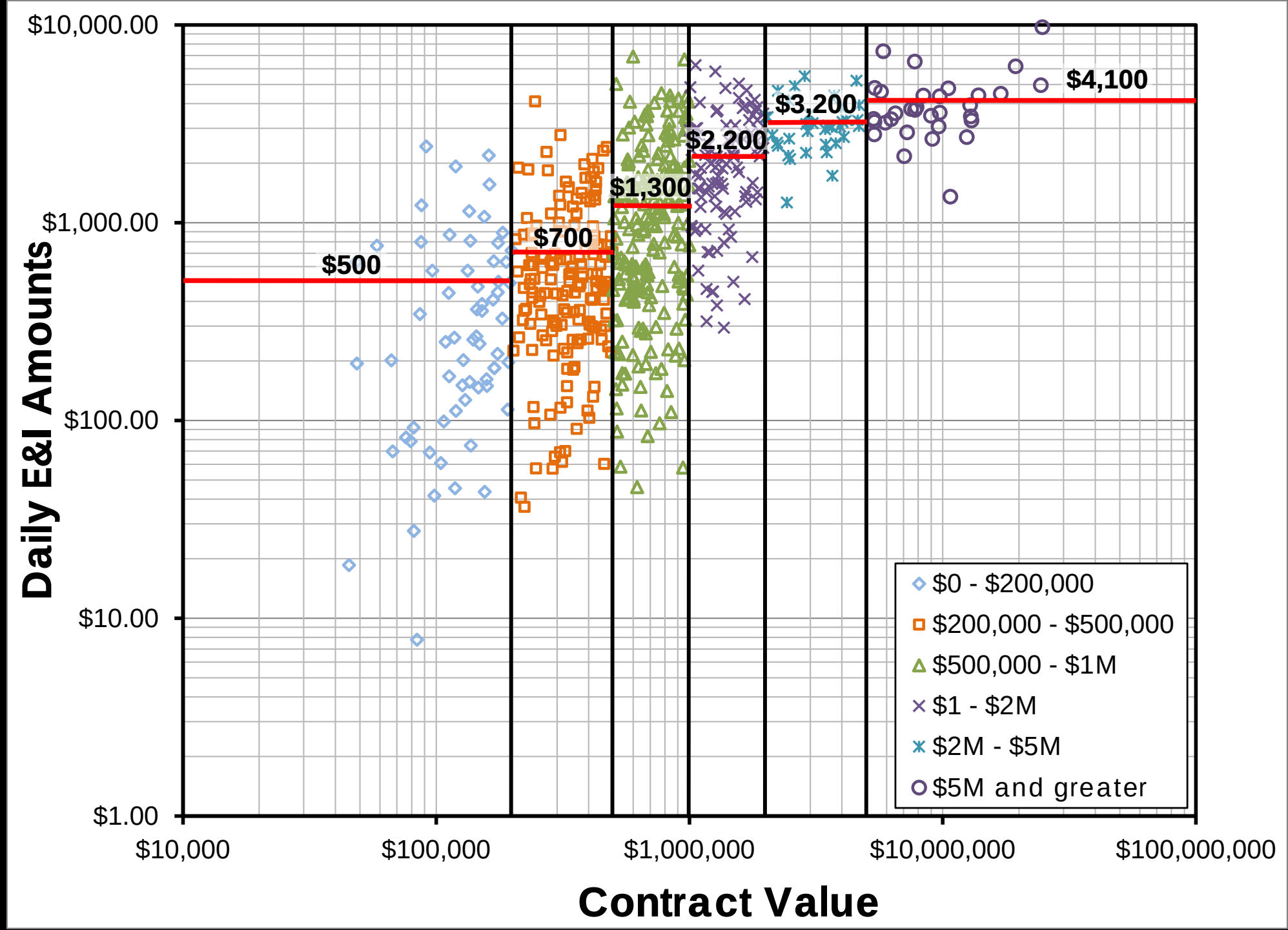
1 & 2 redefined

3 – 6 unique groups

7 & 8 redefined

| Group | Contract Amount | |
|---|---|---|
| | From | To and Including |
| 1 | $0 | $100,000 |
| 2 | $100,000 | $200,000 |
| 3 | $200,000 | $500,000 |
| 4 | $500,000 | $1,000,000 |
| 5 | $1,000,000 | $2,000,000 |
| 6 | $2,000,000 | $5,000,000 |
| 7 | $5,000,000 | $10,000,000 |
| 8 | $10,000,000 | ---------- |

# Work Day LD Rates



# Calendar Day Rates

- Each day was evaluated using historical rainfall data
- ALDOT engineers used experience and engineering intuition to determine if a full work day was feasible
- Calendar rates were determined to be ½ of working day rates

| Average Available Workdays | | | | | |
|---|---|---|---|---|---|
| Month | Division | | | | Statewide Average |
| | 1 & 2 | 3, 4 & 5 | 6 & 7 | 8 & 9 | |
| January | 11 | 12 | 15 | 16 | 13.5 |
| February | 10 | 12 | 15 | 15 | 13.0 |
| March | 15 | 16 | 16 | 16 | 15.8 |
| April | 16 | 17 | 17 | 18 | 17.0 |
| May | 16 | 17 | 18 | 19 | 17.5 |
| June | 15 | 15 | 15 | 15 | 15.0 |
| July | 16 | 16 | 15 | 16 | 15.8 |
| August | 18 | 17 | 18 | 17 | 17.5 |
| September | 16 | 16 | 16 | 17 | 16.3 |
| October | 18 | 19 | 19 | 19 | 18.8 |
| November | 16 | 16 | 16 | 16 | 16.0 |
| December | 10 | 13 | 15 | 14 | 13.0 |
| **Total:** | **177** | **186** | **195** | **198** | **189.0** |
| **% of 365** | **48%** | **51%** | **53%** | **54%** | **52%** |

# LD Calculation Procedure:

## 2008* Schedule of Damages

| Contract Value | | LD rates | |
|---|---|---|---|
| From | To & Including | Calendar Day | Working Day |
| $0 | $200,000 | $250 | $500 |
| $200,000 | $500,000 | $350 | $700 |
| $500,000 | $1,000,000 | $650 | $1,300 |
| $1,000,000 | $2,000,000 | $1,100 | $2,200 |
| $2,000,000 | $5,000,000 | $1,600 | $3,200 |
| $5,000,000 | ---------- | $2,050 | $4,100 |

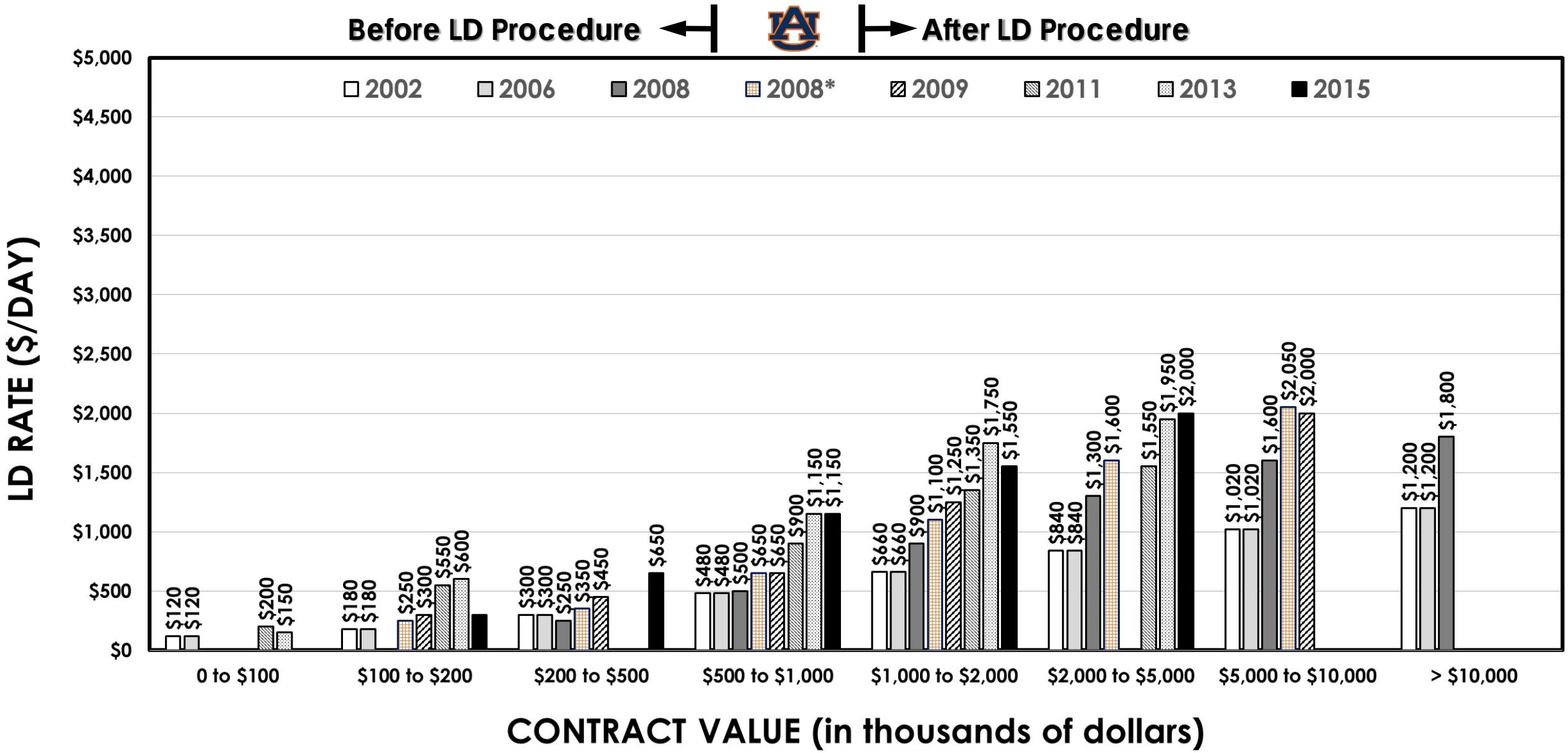
Note: * indicates the rates developed by AU as part of this research project

# ALDOT's Calendar Day LD Rates [13 Years]

| Contract Value | | Liquidated Damages Daily Charges | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| From | To & Including | Calendar Day | | | | | | | |
| | | 2002 | 2006 | 2008 | 2008* | 2009 | 2011 | 2013 | 2015 |
| $0 | $100,000 | $120 | $120 | -- | -- | -- | $200 | $150 | -- |
| $100,000 | $200,000 | $180 | $180 | -- | $250 | $300 | $550 | $600 | $300 |
| $200,000 | $500,000 | $300 | $300 | $250 | $350 | $450 | -- | -- | $650 |
| $500,000 | $1,000,000 | $480 | $480 | $500 | $650 | $650 | $900 | $1,150 | $1,150 |
| $1,000,000 | $2,000,000 | $660 | $660 | $900 | $1,100 | $1,250 | $1,350 | $1,750 | $1,550 |
| $2,000,000 | $5,000,000 | $840 | $840 | $1,300 | $1,600 | -- | $1,550 | $1,950 | $2,000 |
| $5,000,000 | $10,000,000 | $1,020 | $1,020 | $1,600 | $2,050 | $2,000 | -- | -- | -- |
| $10,000,000 | -------- | $1,200 | $1,200 | $1,800 | -- | -- | -- | -- | -- |

**Developed by ALDOT prior to LD Procedure** ← | → **Developed by ALDOT using LD Procedure**

# CALENDAR DAY LD RATES

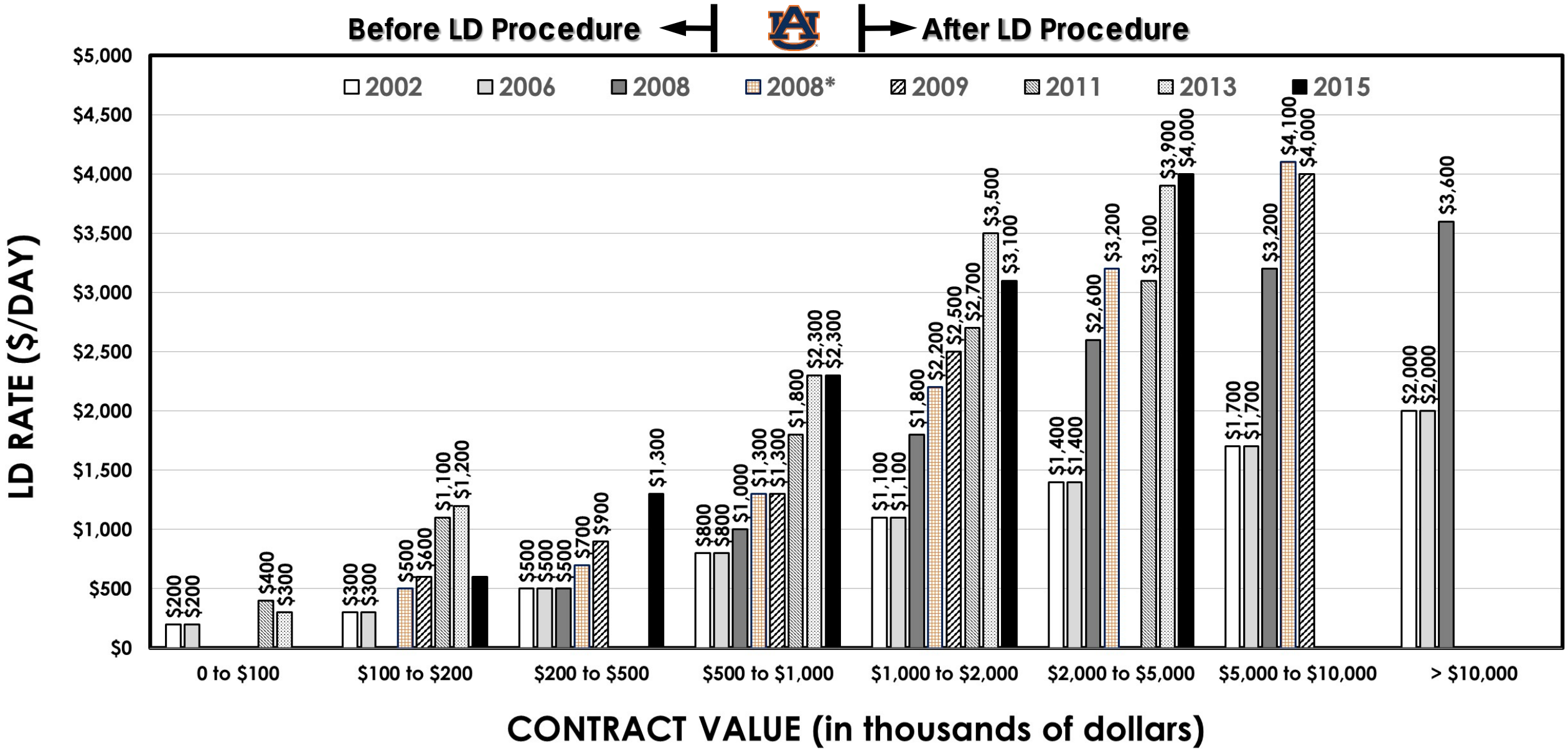


# ALDOT's Work Day LD Rates [13 Years]

| Contract Value | | Liquidated Damages Daily Charges | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| From | To & Including | WORK DAY | | | | | | | |
| | | 2002 | 2006 | 2008 | 2008* | 2009 | 2011 | 2013 | 2015 |
| $0 | $100,000 | $200 | $200 | -- | -- | -- | $400 | $300 | -- |
| $100,000 | $200,000 | $300 | $300 | -- | $500 | $600 | $1,100 | $1,200 | $600 |
| $200,000 | $500,000 | $500 | $500 | $500 | $700 | $900 | -- | -- | $1,300 |
| $500,000 | $1,000,000 | $800 | $800 | $1,000 | $1,300 | $1,300 | $1,800 | $2,300 | $2,300 |
| $1,000,000 | $2,000,000 | $1,100 | $1,100 | $1,800 | $2,200 | $2,500 | $2,700 | $3,500 | $3,100 |
| $2,000,000 | $5,000,000 | $1,400 | $1,400 | $2,600 | $3,200 | -- | $3,100 | $3,900 | $4,000 |
| $5,000,000 | $10,000,000 | $1,700 | $1,700 | $3,200 | $4,100 | $4,000 | -- | -- | -- |
| $10,000,000 | -------- | $2,000 | $2,000 | $3,600 | -- | -- | -- | -- | -- |

**Developed by ALDOT prior to LD Procedure** ← | → **Developed by ALDOT using LD Procedure**

# WORK DAY LD RATES



# Conclusions

1. **Record data inaccuracy:**
   - automatically identifies atypical data and trims data prior to estimating rates
2. **Time consuming process:**
   - approach could be automated no longer requiring personnel to relearn infrequently used techniques
3. **Procedural soundness:**
   - the procedure is sound with rates being estimated directly from actual data.

**Honest and intelligent application will result in developed LD rates that are an *objective* and *statistically justifiable* pre-estimate of anticipated costs.**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# QUESTIONS?

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