

## *CA-specific LS Exam Review Public Land Survey System*

Presented by  
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### *What we know....*

- Knowledge of the PLSS is required for you to function in the Boundary arena.
- Historically, the PLSS questions on the exam were “point rich” and successful completion of many of them were necessary to pass
- We do not know what is on the exam
- We do not know how the questions will be structured

## *Today's goals*

- Increase your awareness of what constitutes foundational knowledge of the PLSS and how that may be tested
- Eliminate surprises as much as possible
- Identify your weak areas and reinforce your strong areas

## *Let's face facts -*

- Time is running out – the exam is just a few weeks away
- If much of this is new to you, you have a LOT of work to do – not an insurmountable task, but it will be difficult
- If you find yourself reasonably comfortable with the material, you probably know it better than you think so long as you are not delusional – today will be a good check.

## *Multiple choice exams*

- We understand that to facilitate machine grading, the exam will now be multiple choice
- Unlike the previous exams which required essay-type answers using a clean piece of paper and your communication skills, the answer is in front of you on the new exam – pick it.
- The door is really open for nit-picking questions, so you must know your stuff

## *Some more reality for you -*

- There are no easy ways out
- The exam will be no easier to pass after you complete this session – the exam remains the same
- The variable in the equation is you.
- No one can do this for you – it is all up to you – so don't look for a short cut – it doesn't exist

## *Let's look at your study routine -*

- Should be in an exam-like environment (library)
- Should have your resources prepared and packaged for exam day (practice with them that way)
- Time is an element of the exam – practice using timed exercises
- If you don't have buy-in from family and friends – get it; your career is at a major threshold and you don't need distractions

## *Real Life vs. The Exam*

- Real life situations seem to always have more to the story than meets the eye therefore requiring extensive records research and evidence analysis to get it right – and what we perceive as “right” may not be the case despite our efforts
- The exam can only present the problem in a narrow and finite way – therefore it has to be more straightforward (aka “what you see is all there is”)

## *More reality and cautions*

- Don't get hung up with hypotheticals – there are infinitely many – stay focused on the fundamental knowledge
- What you experience daily (the stuff which makes for good war stories) will not likely show up as an exam problem

## *The Mind Set*

- Clear your mind of the infinitely many possibilities – they just make for a very low SNR
- Concentrate on the fundamental knowledge and it “will set you free”
- Keep in the back of your mind that this cannot be too complex and still be reduced to an exam question.

## *What particular aspect of the PLSS is bugging you?*

- Talk to me
- I do not want to spend much time on the basic stuff if it is not needed
- I'm willing to spend the entire time just working through your concerns – but if we do that, we'll miss those things you haven't thought about that may show up on the exam
- I'll provide the nuts and bolts – then you tell me how they don't fit well in your mind

## *The structure*

- We will hit the key points
- We will dwell on those areas that are very likely to be addressed on the exam in some form
- There is no fluff – if I've taken the time to include it in this presentation, I consider it important for you to know
- Ask questions as we go in front of the group

## *Schedule*

- We will take the scheduled breaks as published in the agenda
- Since we have a lot of ground to cover (and it is also just my style), the time spent in session will be intense and fast paced. Hold on.
- Please be on time when sessions reconvene

## *Down to business*

- History and key concepts
- Key terms
- Primary layout
- Restoration procedures

*All of this in the context of how it could be presented or tested on the exam*

## *History of the PLSS*

- PLSS began with the Land Ordinance of 1785
- California ceded by Mexico in 1848 and joined the Union on 09Sep 1850
- PLSS surveys began in California in 1851
- Note that Mexican Land Grants existed prior to the PLSS. *Those that were recognized and approved by the U.S. are senior to the PLSS.*

## *Key points regarding LO 1785*

- Land to be surveyed before patent
- Our land tenure system is monument-based – not measurement based
- N.B. – the monument controls (fundamental)



## *Key Terms*

- Initial Point, Baseline, Principal Meridian
- Standard Parallel
- Guide Meridian
- Township line
- Range line
- Township
- Range
- Section
- Latitudinal line
- Meridional line
- Subdivisional lines
- Subdivision-of-section lines

## *Key terms (continued):*

- Aliquot part
- Lot
- Protraction
- Parenthetical distance
- Corner
- Monument
- Accessories – bearing tree, bearing object, reference monument
- Dependent Resurvey
- Independent Resurvey
- Tract

## *Key terms (continued):*

- Subdivision of section
- Existent, Obliterated, Lost corners
- Exhaustive search
- Meander corner, meander line
- Closing Corner
- Witness corner
- Patent
- Bona fide rights
- Navigable waters
- Regular section vs. fractional section

## *BLM Glossary of Surveying and Mapping Terms*

- Excellent resource
- Download at:

<http://www.blm.gov/wo/st/en/prog/more/cadastralsurvey/tools.html>

## *The PLSS Datum*

- Distances are at ground level
  - Watch for exam questions where SPC grid distances and ground distance may be mixed
- Bearings on the official plat and in the field notes reference the true meridian – always
  - The significance being that you need to address convergence if working in a Cartesian system

## *Direction*

- ALL directions are referenced to the True Meridian (astronomic, geodetic, True North often used interchangeably – collectively called “the True Meridian”)
- Geometry around sections will not close due to convergence of meridians
- “straight” lines are lines of constantly changing bearing
- “curved” lines are lines of constant bearing

## *Important Note about Directions:*

- In so far as the Exam goes:
  - For the most part, it will be safe to act as if you are working in a Cartesian system (as opposed to the geodetic system that it really is)
  - Likely the only geodetic element to be encountered on the exam is the latitudinal curve (Standard Parallels, latitudinal township boundaries) – and not so much the mathematics of it but the fact that you know when to make the adjustment to the curve

## *Area*

- Area reported on the official plat is the official area – even though the mathematics will prove otherwise (more on this and the significance of it during the discussion on rectangular limits)
- Used to determine the price of the land to be paid by the patentee
- Unit is the acre

## *Intent of the PLSS*

- Survey and monument lands PRIOR to patenting (deeding) to private citizens
- Provide standard sized and shaped parcels
- Provide a simple means of identification and description by reference to aliquot part, Section, Township, Range, Initial Point:
  - “The SW  $\frac{1}{4}$  of Section 22, Township 13 South, Range 3 East, San Bernardino Meridian.....”
  - “The NE  $\frac{1}{4}$  NE  $\frac{1}{4}$  of Section 10, Township 9 North, Range 18 West, 5<sup>th</sup> Principal Meridian”
- provides for a description of a unique piece of ground

## *The Manual*

- Several issues over time with changing procedures and specifications
- Prior to 1855, instructions were issued by letter
- Manuals of 1855, 1871, 1881, 1890, 1894, 1902, 1930, 1947, 1973
- Manual of 2009
- All written for the Federal Authority Surveyor (more about this later)

## *Surveying under State Authority in PLSS*

- The exclusive authority for the PLSS is the Bureau of Land Management – only they can establish/extend the PLSS
  - Federal employees working under the direction of the BLM
  - CFedS
- State authority surveyors can only retrace and restore – and in some cases establish (careful here!!)
  - Establish true closing position on township and range lines
  - Establish 16<sup>th</sup> and lesser cors in subdivision of section
  - Everything else is restoring what was already established

## *Basic Framework of the PLSS*

- Initial Point
- Principal Meridian
- Base line
- Standard Parallels
- Guide Meridians
- Quadrangles
- Townships
- Sections

## *Initial Point*

- The POB
- California has three:
  - Mt. Diablo established in 1851
  - San Bernardino established in 1852
  - Humboldt established in 1853

## *Principle Meridian*

- Conforms to (“runs on”) the True Meridian
- Extends N/S from the Initial Point
- Section and  $\frac{1}{4}$  sec. cors. est. alternately at intervals of 40 chs.
- Regular Tp. cors. est. at intervals of 480 chs.
- Generally restore lost corners along this line by single proportion (refer to the record!!!!)

## *Base Lines*

- True parallel of latitude (“the latitudinal curve”)
- Extends E/W from the Initial Point
- Std. Sec. and ¼ sec. cors. est. alternately at intervals of 40 chs.
- Std. Tp. cors. est. at intervals of 480 chs.
- Generally restore lost corners along this line by single proportion with adjustment to the latitudinal curve (refer to the record!!!!)

## *Standard Parallels*

- Just like baselines, but generally not est. with same care
- True parallel of latitude – “the latitudinal curve”
- Aka “correction lines”
- Extend E/W from Principal Meridian at intervals of 24 miles N or S of the Baseline
  - May also have been placed at intervals of 30 or 36 miles
  - Bottom line – it doesn’t matter – the record will dictate!!
- Generally restore lost corners along this line by single proportion with adjustment to the latitudinal curve (refer to the record!!!)



## *Guide Meridians*

- Run on the True Meridian
- Extend N from the baseline or the Standard Parallels (could also extend S – depends on the record and the instructions)
- Intersects the next Std Parallel to the North (or South)
  - Closing Tp. cor. est. at the point of intersection
- Sec. and  $\frac{1}{4}$  sec. cors. est. alternately at intervals of 40 chs.
- Excess or deficiency placed in last  $\frac{1}{2}$  mile
- Generally restore lost cors. along this line by single proportion (refer to the record!!!)

## *Township exteriors*

- S & E tp. Boundaries generally control the subdivision of the tp. (refer to the record!!!)
- Meridional tp. Lines (N/S lines)
  - Run on True Meridian
  - Excess or deficiency of the tp. Line closing onto the Std. Parallel to the N thrown into the last  $\frac{1}{2}$  mile
    - Closing cor. est. at point of intersection
    - All others are nominal 480 chs. ( or as the record indicates!!)

## *Township exteriors (cont'd)*

- Latitudinal Tp. Lines (E/W lines)
  - Run as “random and true”
  - Excess or deficiency thrown into the last (westernmost) ½ mile
  - Generally no jogs within the quadrangle – result is one cor. common to four tps.

## *General order of establishment*

- Initial Point
- Base line and Meridian
- Standard Parallels and Guide Meridians to create quadrangles
- Subdivide the quadrangles to create townships
- ....as indicated by the record!!!

## Townships

- Even though the term “township” refers to a “row” or tier, and the term “range” refers to a “column”, the term “township” is used to collectively delineate the nominal 6 mile square area of 36 square miles (+/-).
- Designated as Township X North or South of the baseline, Range Y East or West of the Meridian:
- For example: *T 15 S – R13E, SBM would have it's NW corner at the top of the 15<sup>th</sup> row (or 14 x 6 = 84 miles south of the (San Bernardino) baseline and on the west boundary of the 13<sup>th</sup> column (12 x 6 = 72 miles east of the San Bernardino meridian)*

## Townships

- Subdivided into 36 units of one mile square each (1 sq. mile +/-) - “sections”
- Sections are numbered “as the oxen plows” beginning in the NE cor. and progressing E to W, then W to E through the township with Sec. 36 in the SE cor.
- Section lines also known as “subdivisional lines” (not to be confused with “subdivision-of-section lines”)

## *Subdivision of the Township*

- Object of the plan is to secure the maximum number of normal sections
- Meridional lines are run as “true” with  $\frac{1}{4}$  sec. and sec. cors. set a 40 ch. Intervals
  - except for the northern tier
  - Run parallel with E tp. Boundary
- Latitudinal lines generally run “east on random, west on true”
  - Except for the western tier
  - Generally run parallel with the S. tp. Boundary

## *The procedure of subdividing the township*

- How it was supposed to be done
- How it WAS done may be a very different thing:
  - Various ways to short cut to increase production
  - The record may or may not indicate what was actually done, but rather will likely report the survey as it should have been done – so consider these possibilities in retracement!!

*So, if it was not done by the book,  
does that make it incorrect?*

- NO!!!!
- Since the original monuments and lines control, it doesn't matter how they got them in there – they still represent the legal positions!!
- It is YOUR JOB as a Professional Surveyor to figure out WHAT they did and restore all corner points to their ORIGINAL positions!!
- Often easier said than done – this is what separates the “Men from the boys” so to speak (sorry Ladies...)

*Rectangular Limits*

- Generally thought to be statements on allowable errors of closure – only somewhat true...
- The big deal about rectangular limits is how they impact reported acreages and how you derive lot dimensions within sections (more on this in a minute)

## *Rectangular limits in force via the Manual*

- 21' , 50 lks., 5% area
- Exceeding any one of these elements can create the need for lots
- Will influence the dimensions of lots – and how closing sections are subdivided (or other sections with “defective” boundaries)

## *If the rectangular limits are met:*

- Sections (and their aliquot parts) are reported as nominal in area....
  - Section – 640 ac.
  - $\frac{1}{4}$  sec. – 160 ac.
  - $\frac{1}{16^{\text{th}}}$  sec. – 40 ac. (and so on)

.....EVEN THOUGH THE MATH DOESN'T WORK!!!
- More on lot dimensions later

## *The Section*

- 8-sided figure
- 8 controlling corners
- Anatomy of the Section
- The aliquot part
- Corner nomenclature
- Subdivision of the regular section

## *Corner nomenclature*

- Naming convention
- System of Marking Monuments

## *Subdivision of a regular section*

- Sections interior to the township
- Closing sections

## *Lots*

- Why they exist
- Numbering scheme
- Dimensions of lots
  - Parenthetical distances
  - Dimensions from areas on the plat
  - Rectangular limits (again)



## *Descriptions in closing sections*

- Not the NE  $\frac{1}{4}$  NE  $\frac{1}{4}$  of Section 1 – should be Lot 1 Section 1.
- Not the E  $\frac{1}{2}$  Lot 1 Section 1 – this is no longer an aliquot part and therefore cannot be treated as such
- If subdividing lots, use metes-and-bounds descriptions or “of”, “-ly” descriptions

## *Section – regular or fractional?*

- Regular – all  $\frac{1}{4}$  cors. were or could be established
- Fractional – not regular
- Examples
- What difference does it make?

## *Subdivision of the Fractional Section*

- Center  $\frac{1}{4}$  line (and others) on weighted mean bearing
- Calculating the weighted mean bearing
- Variations on procedure

## *Exam focus*

- Your understanding of the structure of the PLSS
- Restoration of lost and obliterated corners
  - You can count on “an award winning” number of points to come from this category
  - Know this like the back of your hand
  - Know this like the back of both hands

“When pressed to the wall over why something was done, the non-professional will not have a good reason.”

“If you do not understand the principles, you cannot fully understand the issues and you are flattering yourself to consider yourself a professional”

*Joel Lenninger, Professional Surveyor Magazine, 1996.*

## *What controls*

- Section cor
- ¼ section cor
- MC
- Line trees
- WC
- RP
- Topo calls on or off the line can control to varying degrees

## *Corners are either:*

- Existent
- Obliterated
- Lost - the only corner category that is restored by mathematical means – everything else is based on the evidence at hand.

Remember – on the exam and in real life, the answer rarely lies in the math. It's in the evidence. Don't rush to a mathematical solution.

## *Existent Corners*

- *An existent corner is one whose position can be*
  - *identified by verifying the evidence of the monument or its accessories, by reference to the description in the field notes, or*
  - *located by an acceptable supplemental survey record, some physical evidence, or testimony.*

*continued*

*“Even though its physical evidence may have been entirely disappeared, a corner will not be regarded as lost if its position can be recovered through the testimony of one or more witnesses who have a dependable knowledge of the original location.”*

*N.B.*

*“No decision should be made in regard to the restoration of a corner until EVERY means has been exercised that might aid in identifying its true original position. The retracements will indicate the probable position and will show what discrepancies are to be expected. Any supplemental survey record or testimony should then be considered in the light of the facts thus developed.”*

## *Obliterated Corners*

- *An obliterated corner is one at whose point there are no remaining traces of the monument or its accessories, but whose location has been perpetuated, or the point of which may be recovered beyond reasonable doubt\* by the acts and testimony of the interested landowners, competent surveyors, other qualified local authorities, or witnesses, or by some acceptable record evidence.”*

## *continued*

*“A position that depends upon the use of collateral evidence can be accepted only as duly supported, generally through proper relation to known corners, and agreement with the field notes regarding distances to natural objects, stream crossings, line trees, and off-line tree blazes, etc, or unquestionable testimony.”*

## *Lost Corners*

- *“A lost corner is a point of a survey whose position cannot be determined, beyond reasonable doubt\*, either from traces of the original marks or from acceptable evidence or testimony that bears upon the original position, and whose location can be restored only by reference to one or more interdependent corners.”*

## *Existent, Obliterated, Lost, or need more information?*

- A. Found one remaining bearing tree of the four set by GLO
- B. Caltrans has remonumented a sec cor and has records of the GLO evidence they found
- C. A pipe of unknown origin that seems to relate to the original
- D. A pipe of unknown origin that does not seem to relate to the original
- E. A properly proportioned corner with no original evidence present

*Existent, Obliterated, Lost, or need  
more information?*

- F. An undisturbed GLO stone
- G. A witness who saw original evidence and knows exactly where it was located
- H. Found several monuments of unknown origin, with no record for any of them
- I. Found a pipe for a sec cor used by surveyors working in all four secs

*Existent, Obliterated, Lost, or need  
more information?*

- J. A witness who was told about original evidence and knows exactly where it was located
- K. Nothing found
- L. A fence corner, no remaining GLO evidence found, does not relate to the original very well
- M. A road intersection, no remaining GLO evidence found, relates to the original by proportion
- N. Wood post remains



## *Existent, Obliterated, Lost, or need more information?*

- O. Evidence of pits found
- P. Memorial glass found
- Q. Old accessories by County Surveyor to GLO evidence he found
- R. Found two accessories, do not come to the same place
- S. No corner evidence but have good definite topo calls in 3 of the 4 directions, within 2 chains, comes to a small corner locus

## *Note*

- As you can see, there can exist some gray area between “existent” and “obliterated”
- The key is to not declare the corner “lost” until all means have been exhausted.

## *Important note*

*“Although technology makes it simpler to create a mathematical position for a corner point than to search and evaluate physical evidence, evidence of measurement is incompetent to prove an original monument in error.”* Stan French, BLM Cadastral Surveyor.

## *Using accessories*

- BT's were measured to center of the stump (most of the time....)
- Single accessory – record b & d
- Two accessories – dist-dist intersection
- Three or more accessories – locus

### *What we know when we proportion:*

- That the resulting position is not where the original corner stood.
- There is no way the original measurements were of such integrity or consistency for a proportioned position to exactly replicate the corner point - - that's why it is the method of LAST RESORT!!
- You cannot validate the position of a found monument because it fits a theoretical proportioned position. Period.

### *Proportioning*

- “A proportionate measurement is one that gives equal relative weight to all parts of the line.”
- On the exam
  - “single proportionate measure” = “midway and on line”
  - “40 chains proportionate measure”

## *Double Proportion*

- Where it is used
- BoB MUST be astronomic N at point of record
- Cardinal equivalents
- The mechanics
- After calc'ing the point – search again

## *Witness corners*

- Definition
- Restoring cor point where single proportion is indicated
- Restoring cor point where double proportion is indicated

## *Three point control*

- Not an intersection problem!
  - SPM between 2 using cardinal equivalents
  - Record B&D from third
  - Cardinal offsets

## *Two point control*

- Not an intersection problem!
- Record B&D from each point
- Cardinal offsets

## *Single point control*

- Record B&D from known point
- NOTE: True Meridian at the point of record must be the basis for the direction!!
- Index may be applied to distance – but must be based on extensive analysis of measurements (rare)

## *Grant Boundary Adjustment*

- Simple scale and rotate
- What is held and what gets adjusted?
- Does BoB matter in this procedure?

## *Others*

- Irregular boundary adjustment [7-51 et seq]
- Angle Points of Meander Lines [7-53 et seq]

## *Multiple Choice Exams*

- Determine minutes per question
- Watch your time
- Make first pass through on easy ones – flag the others
- Return to the unanswered questions and leave those with time-consuming calcs to the end
- Leave no question unanswered – take your best guess

## *Contact Information*



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