1. Products and services:
   - imagery
   - lidar
   - planimetric data
   - land use land cover

2. Next steps
Timeline

**Q1** - **Odd Year**
- **Plan**
  - DRCOG identifies stakeholders and gathers requirements for upcoming projects.

**Q2** - **Even Year**
- **Collect**
  - Data collection begins for imagery and lidar projects.

**Q3** - **Odd Year**
- **Quote**
  - DRCOG quotes potential partners for participation in upcoming projects.

**Q4** - **Even Year**
- **Process**
  - The vendor processes imagery and lidar data according to our specifications.

**Q1** - **Odd Year**
- **Commit**
  - DRCOG asks stakeholders to commit to projects by submitting signed letters of intent for a specified contribution amount.

**Q2** - **Even Year**
- **Check**
  - Partners validate the data to ensure it meets their needs and adheres to specifications.

**Q3** - **Odd Year**
- **Contract**
  - DRCOG contracts with vendors to complete the scope of work agreed upon and funded by the partnership.

**Q4** - **Even Year**
- **Deliver**
  - Imagery and lidar products and services are delivered at the end of this quarter and into the next.

**Q1** - **Odd Year**
- **Develop**
  - Development begins on products that are derived from imagery and lidar like planimetric data and land use land cover.

**Q2** - **Even Year**
- **Process**
  - The vendor processes planimetric data and land use land cover data according to our specifications.

**Q3** - **Odd Year**
- **Check**
  - Partners validate the data to ensure it meets their needs and adheres to specifications.

**Q4** - **Even Year**
- **Deliver**
  - Planimetric data and land use land cover products are delivered at the end of this quarter and into the next.
IMAGERY 2020
1. custom flight imagery (provided by Sanborn) and final web map service
2. supplemental streaming imagery service and obliques (Nearmap)
• four-band orthoimagery
• February through April and June through July flight windows (Denver metro area and mountains, respectively)
• snow-free and leaf-off
• meets American Society for Photogrammetry and Remote Sensing positional accuracy standards for mapping and geographic information systems work
• independent quality control provided by partners
• Download historic data samples from OIT
Delivery formats:
- GeoTIFF
- JPG2000

Delivery projections:
- State Plane Colorado Central (0502), NAD83 (2011), feet
- State Plane Colorado North (0501), NAD83 (2011), feet
- UTM Zone 13 North, NAD83 (2011), meters

Streaming services:
- interim quality analysis and quality control web map tile service (Sanborn)
- final and historical web map service (Harris)
Custom flight imagery (Sanborn)

Very similar to the 2018 project boundaries:

- DRCOG added more 3-inch in Aurora.
- DRCOG did not add more 6-inch in Jefferson County, as previously discussed.
• The spring and summer flight boundary is the same as in 2018.

• Proposals to change were expensive due to increased flight lines.

• Shadows in the foothills during spring collection will be mitigated by using stricter sun angle requirements in Sanborn’s contract.
Major milestones:

- **January 2020** – aesthetics survey
- **March 2020** – flights in the Denver metro area and plains; first round of billing*
- **May 2020** (or sooner) – Interim web map tile service (Sanborn)
- **June 2020** – flights in the mountains
- **October-November 2020** – quality control
- **December 2020** – second round of billing*
- **December 2020** (or sooner) - final web map service (Sanborn) ← limited lifespan
- **February 2021** – final web map service (Harris) ← with new addition: https
- **January 2021** – hard drives ← Faster if we simplify orders?

*The default is 60% in March and 40% in December. If you want to make a different arrangement, contact Ashley Summers at asummers@drcog.org.
Remember DRAPP licensing:

- Imagery is proprietary until superseded by a new version.
- The newest version is for internal use only (includes contractors).
- Old versions are in the public domain.
# Custom flight vs. Nearmap streaming

<table>
<thead>
<tr>
<th></th>
<th>DRCOG custom flight</th>
<th>Nearmap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>3-inch, 6-inch, 12-inch</td>
<td>3-inch</td>
</tr>
<tr>
<td>Flight dates</td>
<td>spring for front range; summer for mountains</td>
<td>two to three times per year</td>
</tr>
<tr>
<td>Data delivery date</td>
<td>the following winter (December-January)</td>
<td>within two weeks</td>
</tr>
<tr>
<td>Full coverage of region</td>
<td>yes – 6,000 square miles</td>
<td>no – 2,100 square miles</td>
</tr>
<tr>
<td>Custom flights</td>
<td>yes</td>
<td>potentially, but not right now</td>
</tr>
<tr>
<td>Accuracy</td>
<td>3-inch = 6-inch root mean square error</td>
<td>3-inch = 36-inch root mean square error (users are reporting accuracy at 18-inch root mean square error)</td>
</tr>
<tr>
<td></td>
<td>6-inch = 12-inch root mean square error</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-inch = 24-inch root mean square error</td>
<td></td>
</tr>
<tr>
<td>Independent quality control/DAT</td>
<td>yes</td>
<td>unknown</td>
</tr>
<tr>
<td>Tile delivery</td>
<td>tile delivery on hard drive</td>
<td>tile delivery on hard drive</td>
</tr>
<tr>
<td>Streaming service</td>
<td>Streaming services via Sanborn and Harris. Unlimited users and usage. (two-year term)</td>
<td>Streaming services. Unlimited users and usage. (two-year term)</td>
</tr>
<tr>
<td>Includes historical</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>License</td>
<td>perpetual license (tiles); two-year subscription (services)</td>
<td>subscription only</td>
</tr>
<tr>
<td>Supports DRCOG's planimetric data</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
Supplemental streaming imagery service (Nearmap)

- unlimited users, unlimited data
- two-year term (Jan. 1, 2020 to Dec. 31, 2021)
- two flights guaranteed (typically spring and fall)
- two on-premises deliveries (leaf-on in 2020 and leaf-off in 2021)
- access to historical imagery
- access to obliques
- ability to use the imagery in internal-facing webmaps
- API access
- must have an ArcGIS Online account to access the data
- limited data coverage – not the whole region

To get Nearmap access, your letter of intent must contain a funding commitment for it and an acknowledgement to abide by their terms.

Terms will be emailed to you – they are different than what is on Nearmap’s website.
1. Colorado Department of Transportation
2. Regional Transportation District
3. Denver Water
4. Adams County
5. Broomfield
6. Clear Creek County
7. City and County of Denver
8. Douglas County
9. Gilpin County
10. Jefferson County
11. Arvada
12. Aurora
13. Bennett
14. Brighton
15. Castle Pines
16. Castle Rock
17. Centennial
18. Cherry Hills Village
19. Commerce City
20. Dacono
21. Englewood
22. Erie
23. Federal Heights
24. Firestone
25. Frederick
26. Glendale
27. Golden
28. Greenwood Village
29. Lafayette
30. Lakewood
31. Littleton
32. Lone Tree
33. Longmont
34. Louisville
35. Nederland
36. Northglenn
37. Parker
38. Superior
39. Thornton
40. Westminster
41. Wheat Ridge
42. Arapahoe County Water and Wastewater Authority
43. United Power
44. Metro Wastewater
45. Jeffcom 911
46. South Suburban Parks and Recreation
47. South Metro Fire and Rescue
Approximately 5,000 square miles of lidar are proposed for collection.

Deliverables, captured according to USGS Lidar Base Specifications:

- classified lidar point cloud: quality level 2 and quality level 1
- bare-earth digital elevation model
- first return intensity raster
- breaklines
- Federal Geographic Data Committee metadata
- 1-foot and 2-foot machine-generated contours ←add-on
If the grant is awarded, DRCOG will collect quality level 1 and quality level 2 lidar as well as 1-foot and 2-foot contours.

**Process:**

1. Make features classes from contour keypoints and hydro features and breaklines. Buffer by 100 feet.
2. Create contour terrain.
3. Use Esri surface contour tool to create contours.
4. **Smooth using PAEK 5-foot.**
5. Contours isolations below 50-feet are removed from the contour dataset.
6. Contours are coded for layer type and then clipped to the project boundary.
7. Run topology tool and make any necessary fixes.

**Major milestones:**
- December 2019 – award results expected
- March 2020 – first round of billing*
- Spring 2020 – lidar capture
- Winter 2020 – second round of billing*
- Spring and summer 2021 – delivery from U.S. Geological Survey
- Summer and fall 2021 – data will be publicly available

*The default is 60% in March and 40% in December. If you want to make a different arrangement, contact Ashley Summers at asummers@drcog.org.*
| Lidar partners                      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  |
|------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lidar partners                      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  |
| 1. Colorado Water Conservation Board |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2. Denver Water                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3. Adams County                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4. Clear Creek County               |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5. City and County of Denver        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6. Douglas County                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7. Gilpin County                    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 8. Jefferson County                 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 9. Arvada                           |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 10. Aurora                          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 11. Bennett                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 12. Brighton                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 13. Castle Pines                    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 14. Castle Rock                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 15. Centennial                      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 16. Commerce City                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 17. Englewood                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 18. Frederick                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 19. Golden                          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 20. Greenwood Village               |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 21. Lafayette                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 22. Lone Tree                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 23. Longmont                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 24. Louisville                      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 25. Morrison                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 26. Parker                          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 27. Superior                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 28. Thornton                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 29. Westminster                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 30. Wheat Ridge                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 31. Urban Drainage and Flood Control District |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
PLANIOMETRIC DATA AND LAND USE LAND COVER 2020
Derivatives:

- Planimetric data and land use land cover are derivatives of imagery (and lidar, if available).

- Planimetric data refers to vector delineations of features of the built environment.

- Land use land cover refers to wall-to-wall classifications of the landscape.
Planimetric data
vector delineation of discrete features
*Source: Kucera International*

- Ramps
- Edge of Pavement
- Centerline Sidewalks
- Unpaved Trails
- Buildings
- Impervious Surface
- Edge of Pavement
- Driveways
- Parking
- Sidewalks
Land use land cover data
wall-to-wall classification
Source: Conservation Innovation Center
Land use land cover data

wall-to-wall classification

Source: Ecopia Tech
Planimetric data and land use land cover data

Methodologies differ in:
- turnaround time
- cost
- accuracy
- granularity (number of features and classes)
- attribution (heights, widths and types)
- format (vector vs. raster)

These aren’t the only options, and we can mix and match!
Planimetric data and land use land cover data

Major milestones:

- Nov. 15, 2019 to Feb. 14, 2020 – requirements gathering surveys and meetings
- March 2, 2020 – release request for proposals
- March 20, 2020 – submittals due
- March 23, 2020 (week of) – bid evaluation
- March 30, 2020 (week of) – interviews (if needed)
- April 2020 – preliminary quotes to partners for budgeting purposes; board approval for vendors
- Fall 2020 – letters of intent due
- Winter 2021 – new imagery is delivered
- Spring 2021 – new lidar is delivered; derivative projects begin
Upcoming actions for you

- planimetric data and land use land cover requirements gathering survey
- aesthetics survey
- tell DRCOG when you want to be billed (if different from default schedule)
QUESTIONS?

Email me at asummers@drcog.org