Chesapeake Bay Program
Science. Restoration. Partnership.

May 1, 2025

# Methods for Developing the CAST Land Use

## Watershed Technical Workgroup

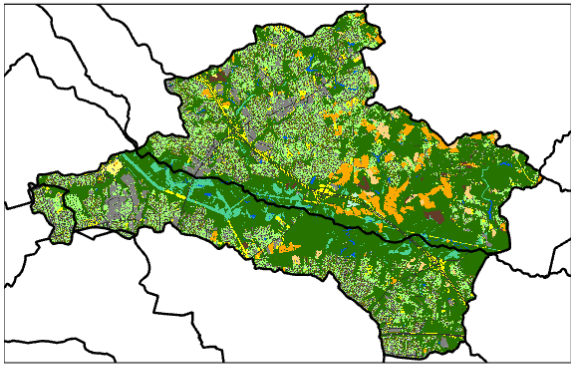
Helen Golimowski

# What does “land use” mean?

**High-resolution LULC**
56 classes

Mapped from aerial imagery, Light Detecting and Ranging (LiDAR), and ancillary data sources.

**Phase 7 Aggregate Land Use**
*16 classes



Reclassifies mapped LULC and summarizes as acres per class per LRSEG to form the base land use for CAST. This also forms the starting point for land use forecasts in the Chesapeake Bay Land Change Model (CBLCM) and the back-cast to the 1980s.

**CAST Land Use**
49* classes (or load sources)

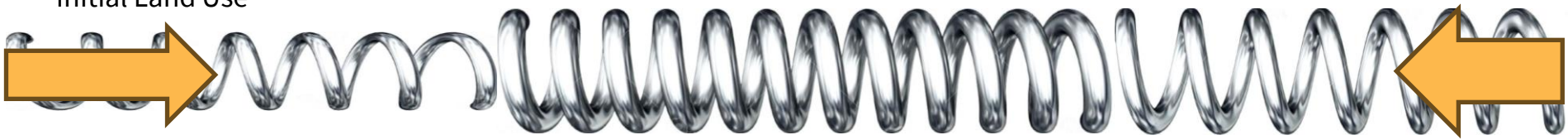
| County | Model Seg | Land Use | Acres |
|---|---|---|---|
| ABC | 1 | Grass | 100 |
| ABC | 2 | CSS Roads | 200 |
| ABC | 3 | Pasture | 50 |
| DEF | 4 | Septic | 35 |
| DEF | 5 | True Forest | 500 |

Incorporates reported data (census of agriculture, state annually-reported forest harvest and construction acres, CSO separations) with the base land use acres. Produces acres of land use by modeling segment in which BMPs are applied and loads are calculated.

LULC = Land Use/Land Cover
LRSEG = Land River Segment
CAST = Chesapeake Assessment Scenario Tool
BMP = Best Management Practice
* Final classification schema for Phase 7 has not yet been approved.

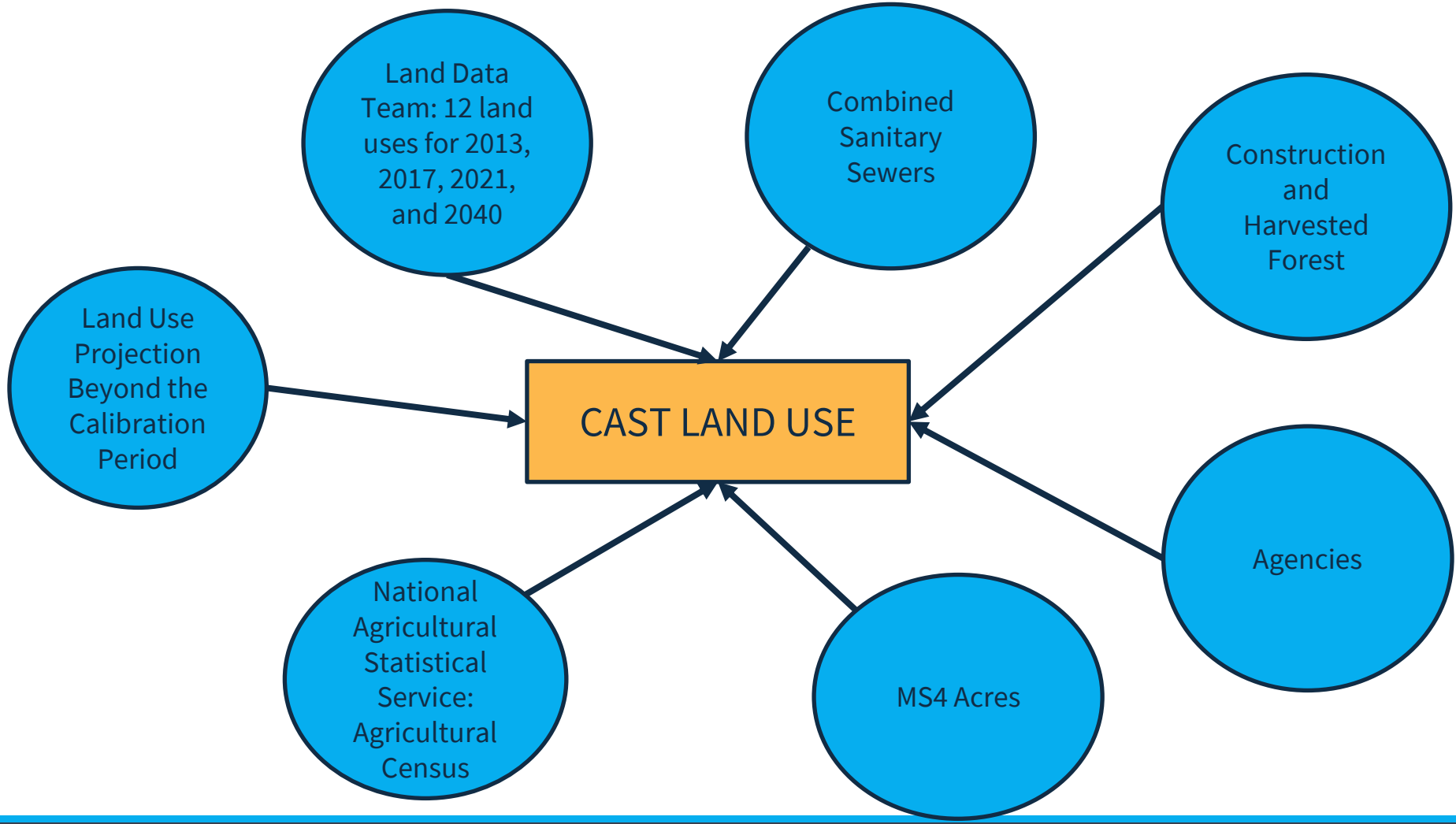
# Exact Physical Analog

Initial Land Use



Land Use Box / Modeling Segment Size

Revised Land Use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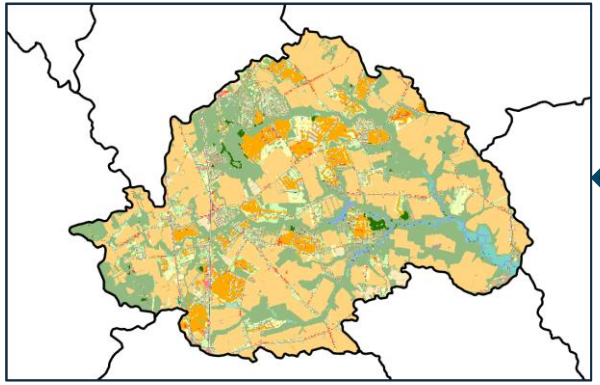
National Agricultural Statistical Service: Agricultural Census
MS4 Acres

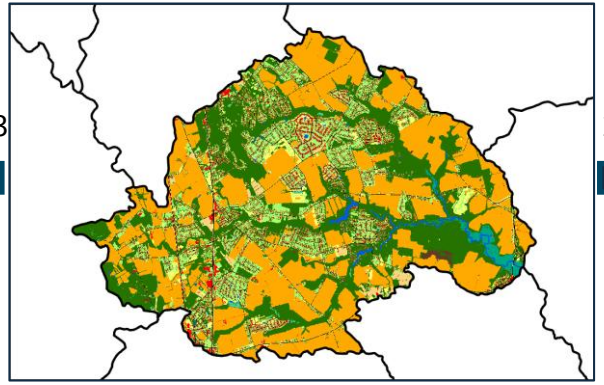
# How does the Land Data Team assess land use over time?

**Past Land Use (30m)**
1985-2012



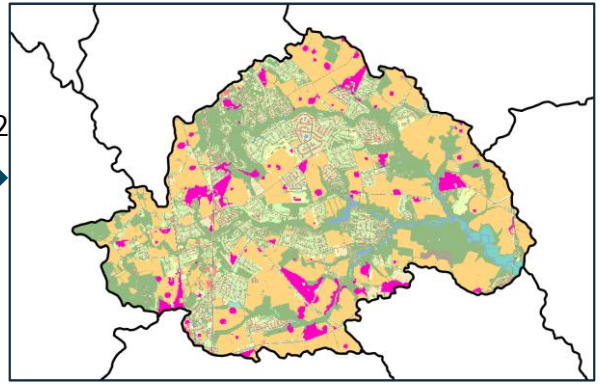
2013

**Present Land Use (1m)**
2013-2022



2022

**Future Land Use (30m)**
2023-2100

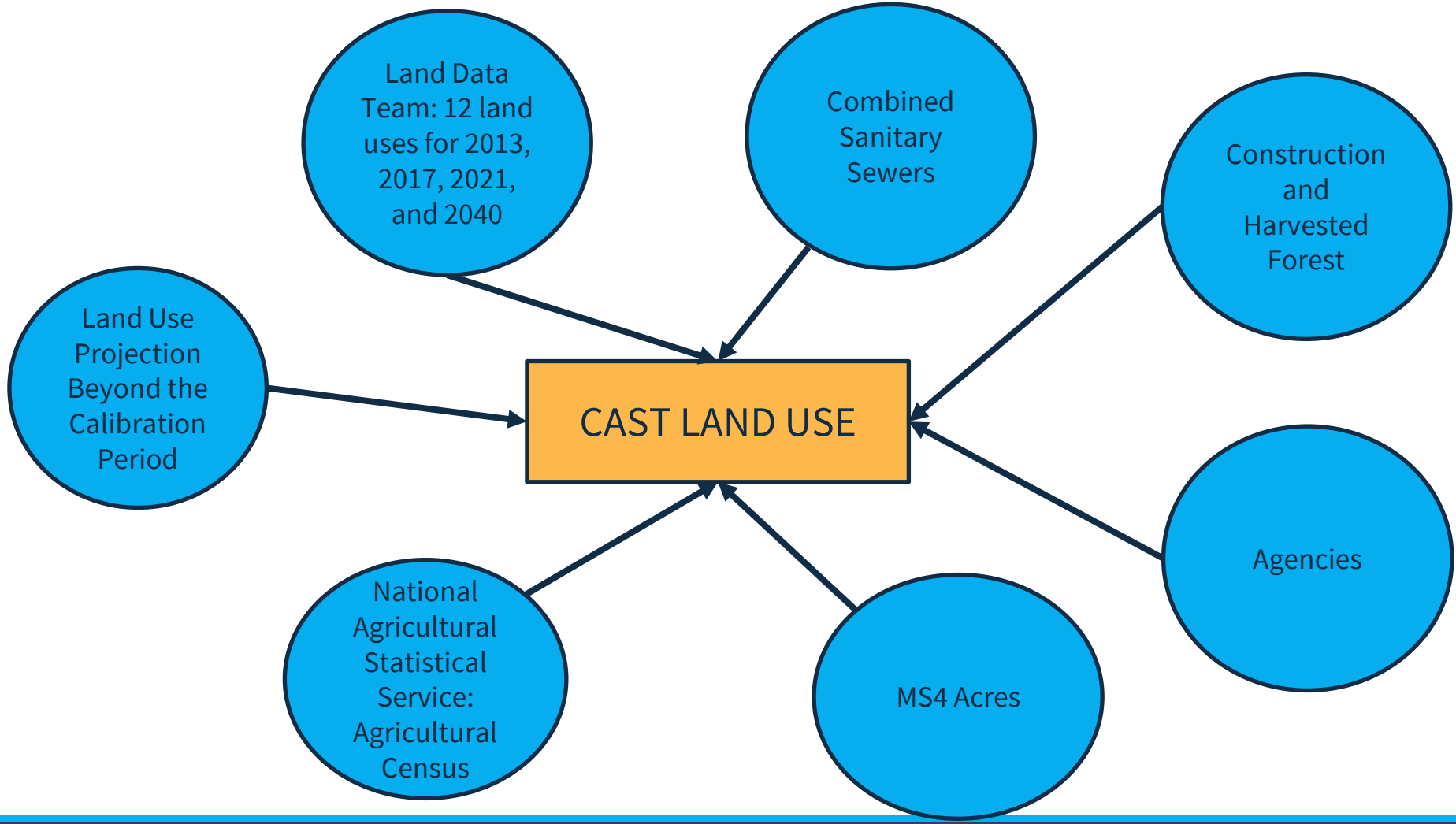


Annual historic land use condition and trends by summary unit. The present is deconstructed where change is detected back through time.

The land use conditions in the present, derived from the LULC at 1-meter resolution and by summary unit. Serves as the starting point for the back-cast and forecasts.

Future land use trends modeled with the Chesapeake Bay Land Change Model (CBLCM). Urban growth model that converts forest and farmland to development to allocate for population growth.

LULC = Land Use/Land Cover
LRSEG = Land River Segment
NLCD = National Land Cover Database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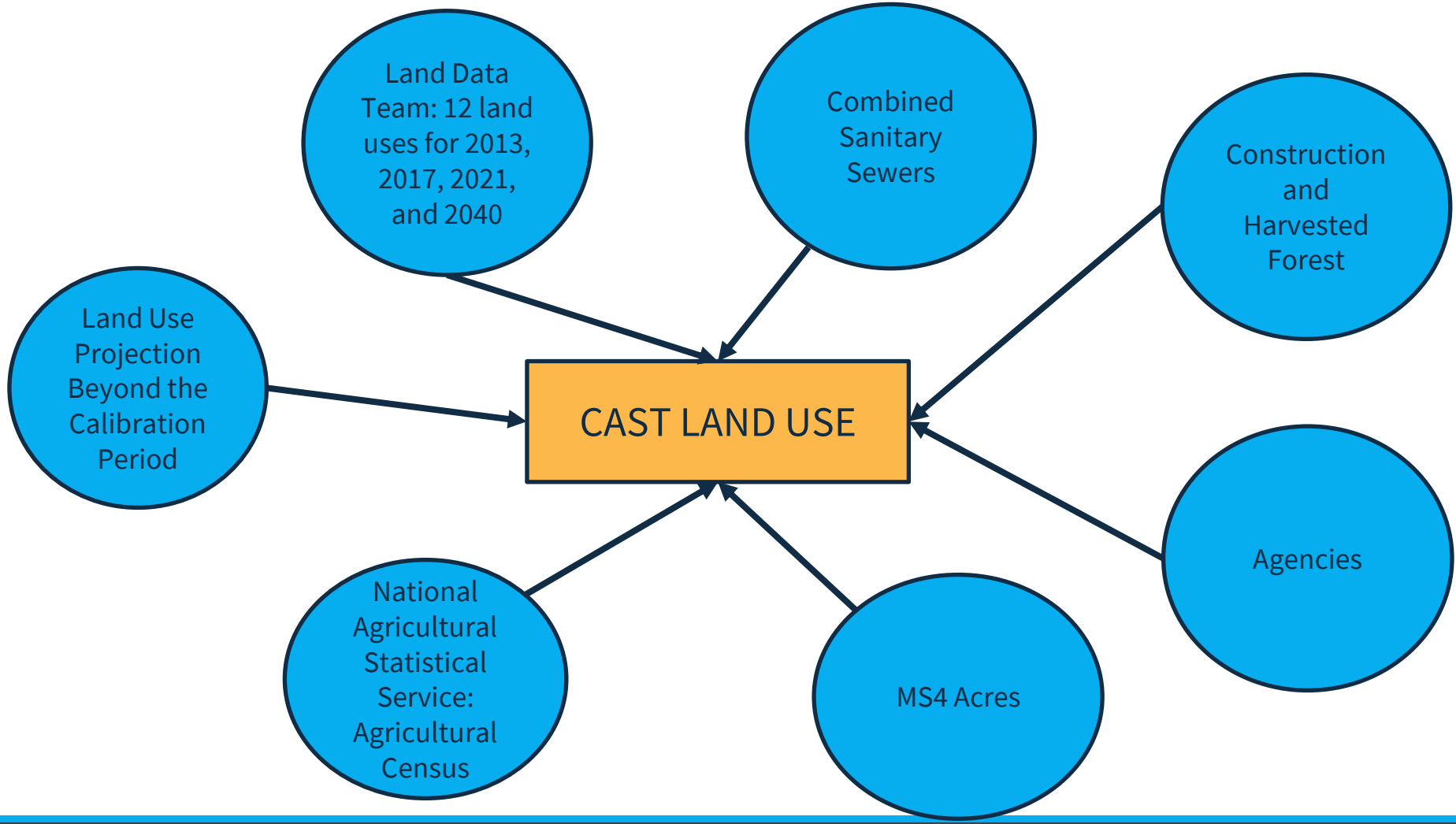
# Combined Sanitary Sewers


- CSS acres held constant across all years
  - Stormwater and sewer separation are reflected in wastewater inputs
  - CSS crop/pasture → CSS a replacement for mixed open (TBD)
  - CSS wetland/water → CSS forest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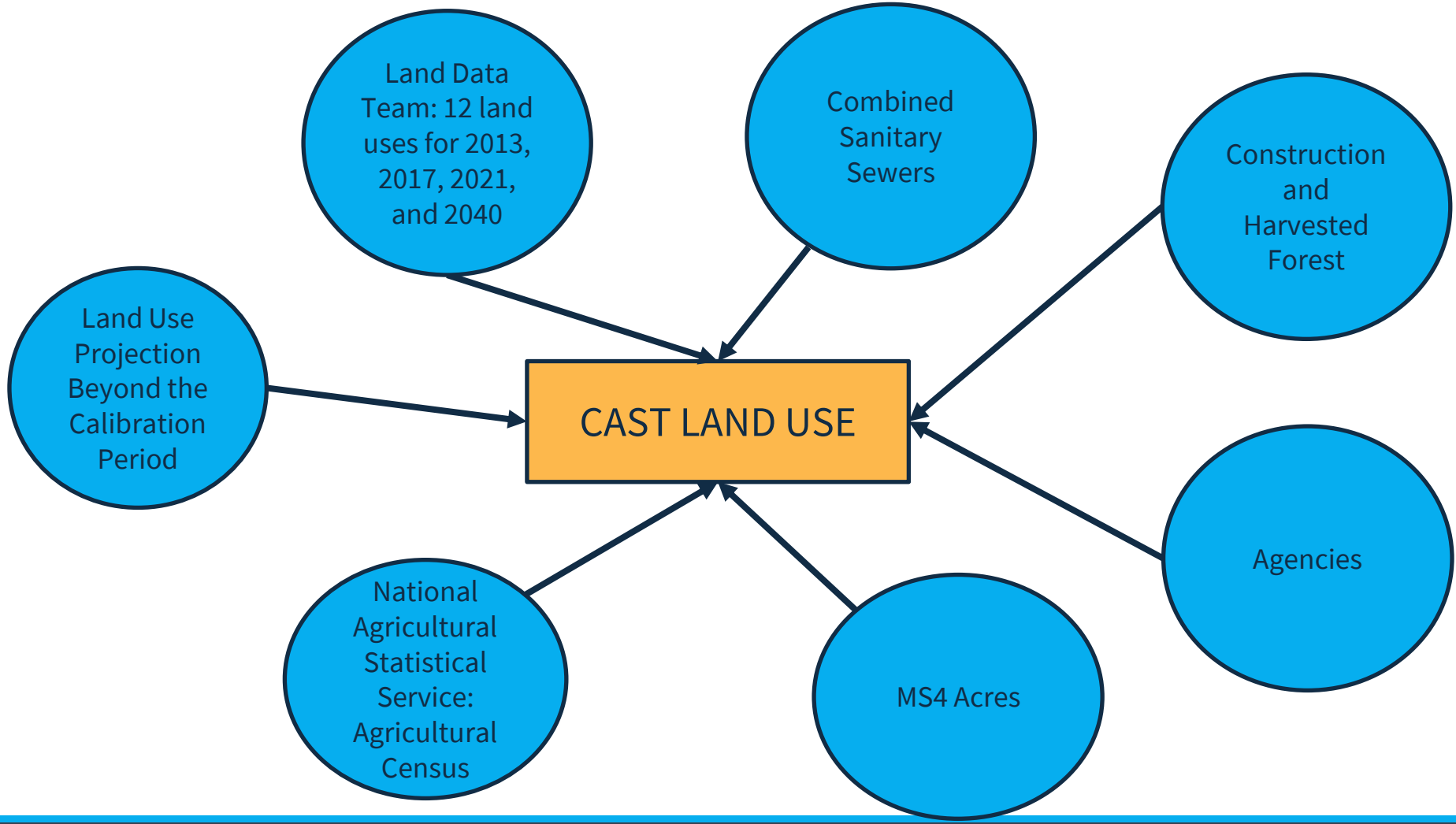
# Construction and Harvested Forest

- Construction acres not derived from mapped land use
  - Submitted by states or calculated as: *1.29 x (Year + 1 dev. acre – Current Year dev. acres)*
  - Developed land use reduced proportionally to accommodate construction
- Harvested forest:
  - Submitted by states or set to 1.1% of forest
  - Reconcile the reported area with the mapped harvested forest area
  - True forest (> 10 acres) reduced proportionally for harvested area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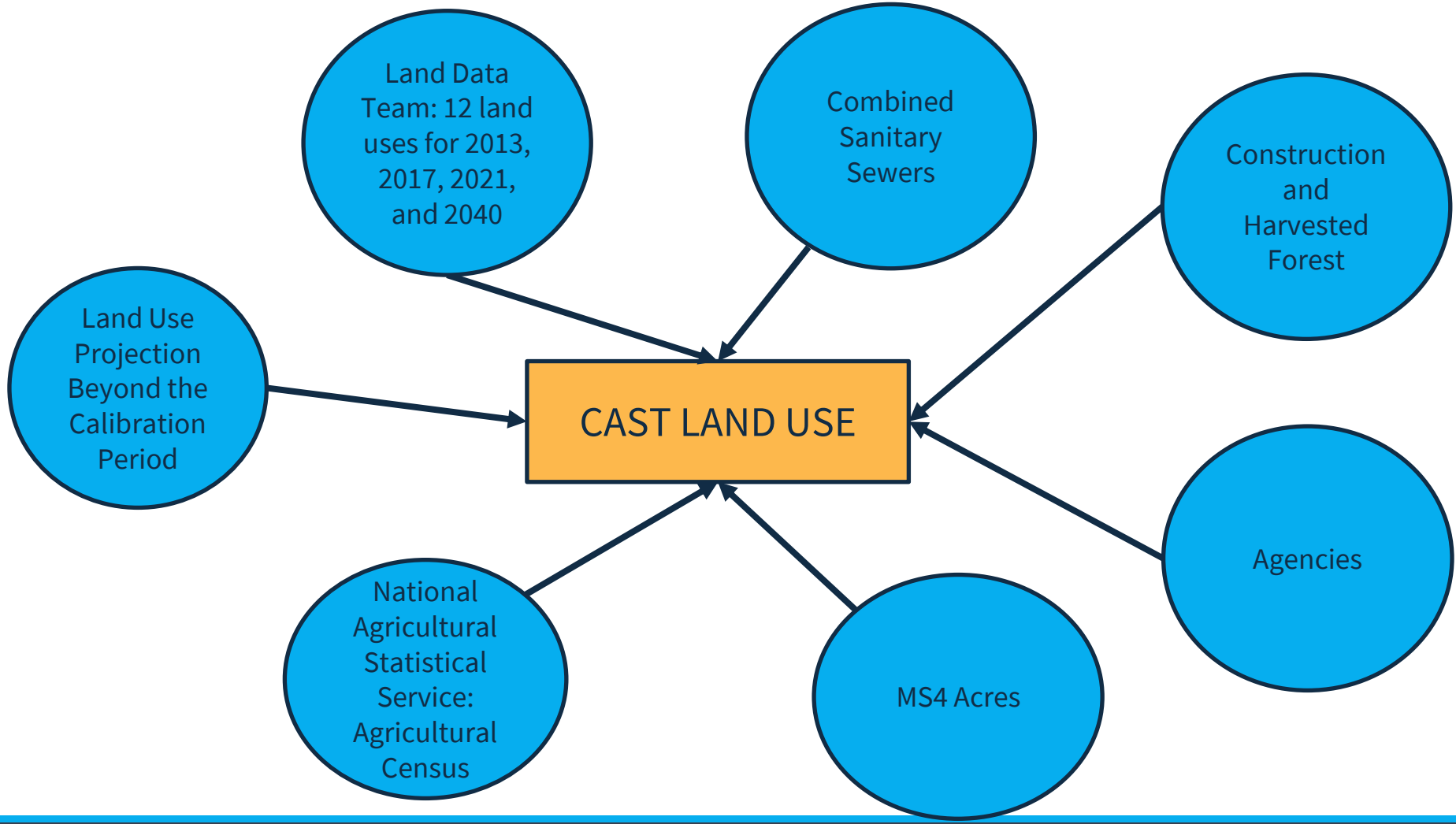
# Agencies

- **Federal Agencies Included in CAST:**
  - US Forest Service
  - US Fish and Wildlife Service
  - Department of Defense
  - Smithsonian Institution
  - Agricultural Research Service
  - General Services Administration
  - National Aeronautics and Space Administration
  - ~~MD State Highway Administration~~
  - National Park Service
  - ~~MD State~~
  - US Army Corps of Engineers

- Federal agency lands remain constant through time
  - Federal:
    → Crop/pasture reassigned to nonfederal agency type
    → Under discussion in FFWG
- Federal Facilities Review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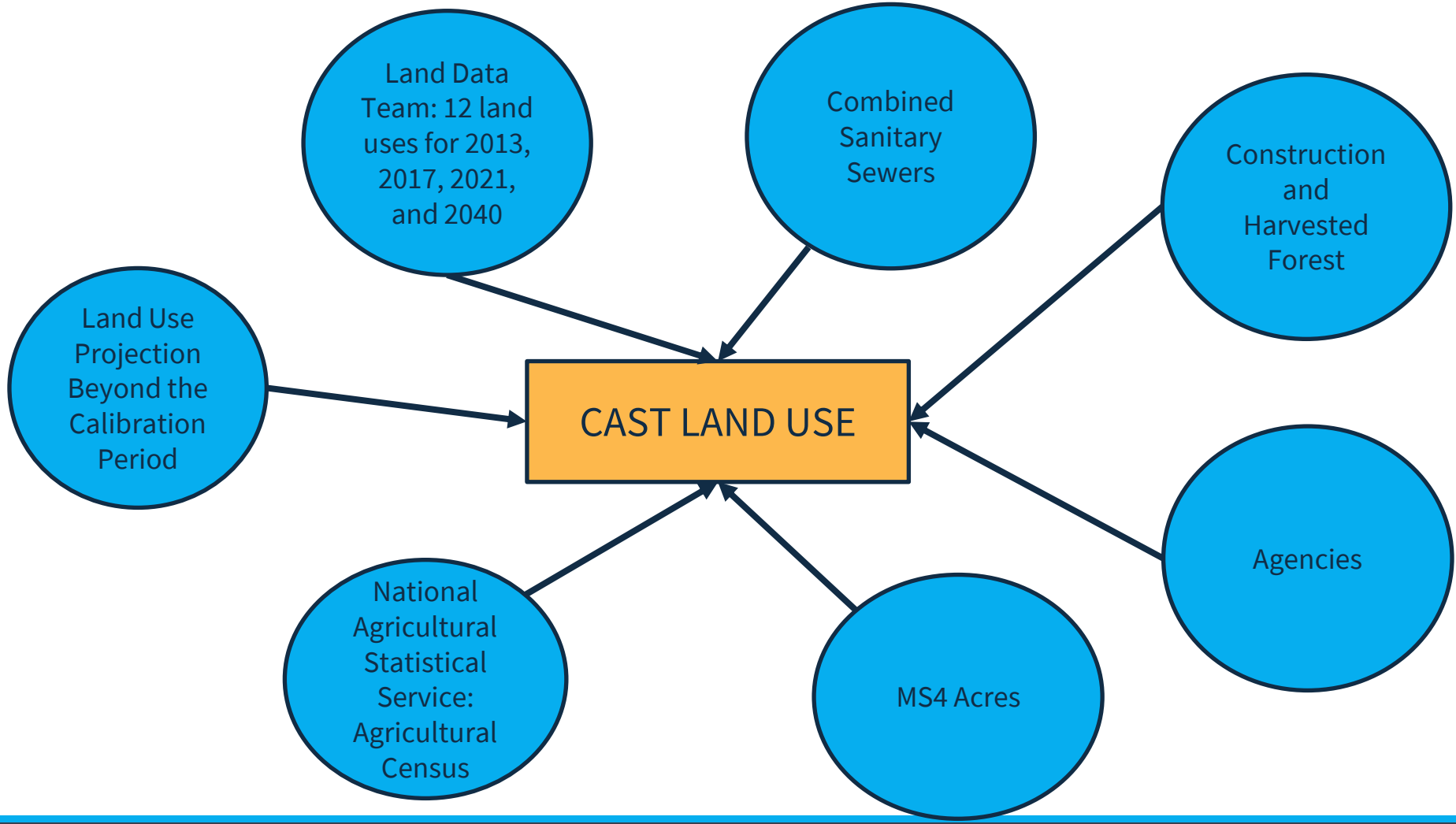
# MS4 Acres

- MS4 acres derived from overlay of: Mapped land use x MS4 boundaries
- Only developed land uses included (e.g., residential, commercial, roads)
- Acres calculated with each modeling segment
- Reflects land regulated under MS4 permits
- Updated as land use and MS4 boundaries change over time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These are the **mapped** land uses

# Proposed Aggregation of High-Res LULC for Phase 7

1. **Impervious, Roads**
   - Roads
2. **Impervious, Non-Roads**
   - Structures
   - Other Impervious (Parking lots, driveways)
   - Extractive Impervious
3. **Tree Canopy Over Impervious**
   - TC over Roads
   - TC over Structures
   - TC over Other Impervious
4. **Turf Grass**
   - Turf Grass
5. **Tree Canopy over Turf Grass**
   - Tree Canopy over Turf Grass
6. **Solar Infrastructure**
   - Solar Field Panel Arrays
7. **Solar Pervious**
   - Solar Field Herbaceous
   - Solar Field Shrubland
8. **Compacted Pervious**
   - Extractive Barren
   - Suspended Succession Barren
   - Suspended Succession Herbaceous
   - Suspended Succession Shrubland
   - Natural Succession Herbaceous (urban areas)
9. **Construction**
   - Bare Developed (Urban areas?)
   - Solar Field Barren
   - Natural Succession Barren (Urban areas)
   - Reported Data from States
10. **Forest**
    - Forest
    - Forested, Other
    - Natural Succession Herbaceous (rural areas)
    - Natural Succession Shrubland
    - Riverine Wetlands Tree Canopy
    - Riverine Wetlands Forest
    - Terrene Wetlands Tree Canopy
    - Terrene Wetlands Forest
11. **Harvested Forest (2)**
    - Harvested Forest Barren
    - Harvested Forest Herbaceous
    - Natural Succession Barren (Rural areas)
    - Reported Data from States
12. **Wetlands, Riverine Non-forested**
    - Riverine Wetlands Barren
    - Riverine Wetlands Herbaceous
    - Riverine Wetlands Shrubland
    - Riverine Wetlands Harvested Forest
13. **Wetlands, Terrene Non-forested**
    - Terrene Wetlands Barren
    - Terrene Wetlands Herbaceous
    - Terrene Wetlands Shrubland
    - Terrene Wetlands Harvested Forest
14. **Cropland**
    - Cropland Barren
    - Cropland Herbaceous
    - Orchards and Vineyards Barren
    - Orchards and Vineyards Herbaceous
    - Orchards and Vineyards Shrubland
15. **Pasture and Hay**
    - Pasture and Hay Barren
    - Pasture and Hay Herbaceous
16. **Water**
    - Lakes & Reservoirs
    - Riverine Ponds
    - Terrene Ponds
    - Streams and Rivers (visible water)
    - Bare Shore- adjacent to lakes

Blue = LULC 56-class schema
White = Phase 7 Aggregate schema

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These are the **mapped agricultural** land uses

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These are the **mapped** agricultural land uses to be further broken down using **ag census** crops.

The crop aggregations are the land uses that come from AMT recommendations.

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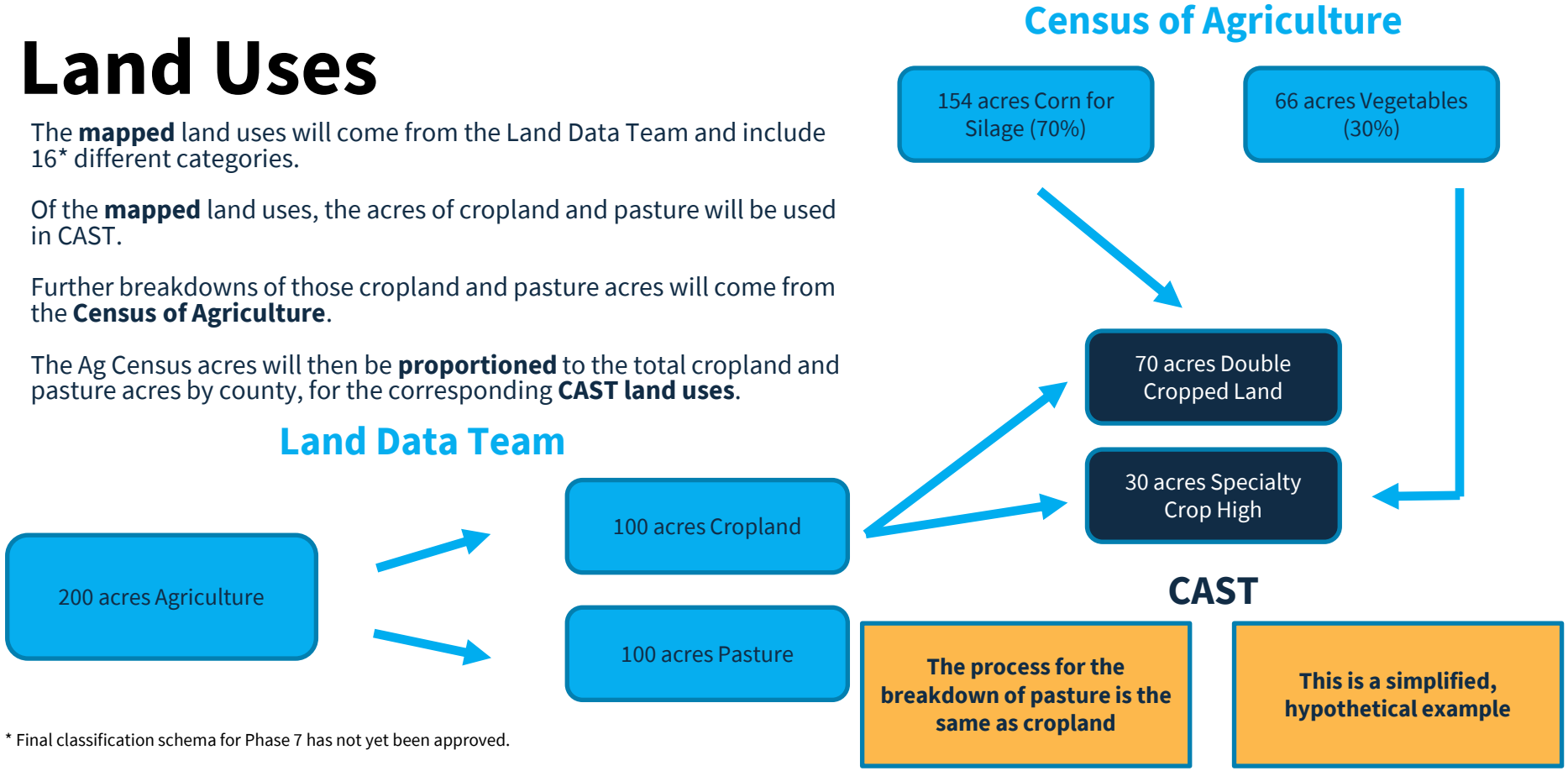
# Land Uses

The **mapped** land uses will come from the Land Data Team and include 16* different categories.

Of the **mapped** land uses, the acres of cropland and pasture will be used in CAST.

Further breakdowns of those cropland and pasture acres will come from the **Census of Agriculture**.

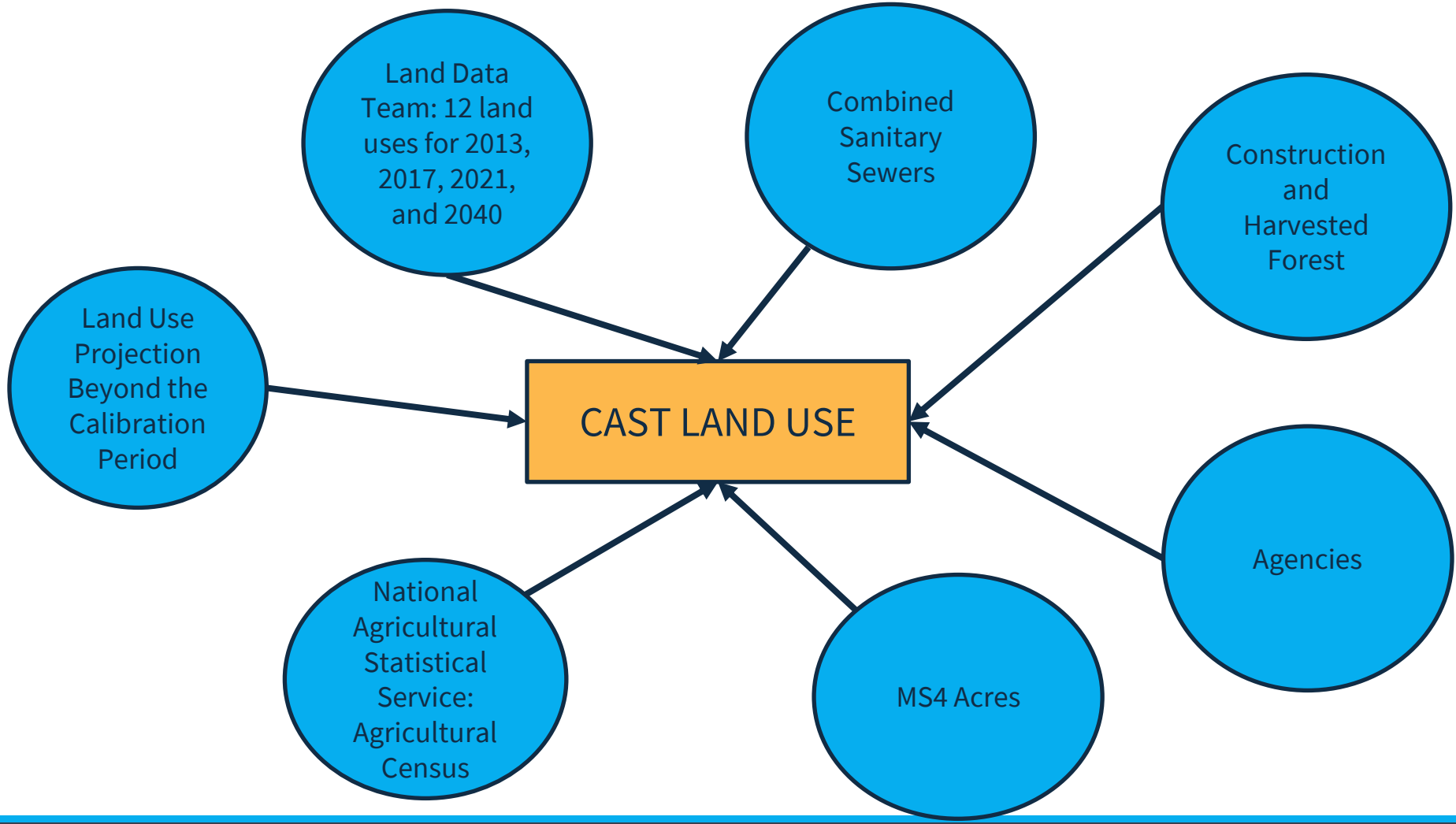
The Ag Census acres will then be **proportioned** to the total cropland and pasture acres by county, for the corresponding **CAST land uses**.




* Final classification schema for Phase 7 has not yet been approved.

# NASS: Agricultural Census

- County data apportioned to modeling segments using mapped classes
  - **Total Ag** → Permitted/Non-Permitted Feeding Space
  - **Pasture** → Ag Open Space, Managed/Unmanaged Hay & Pasture
  - **Cropland** → All other ag uses
- Virginia cities: assigned ag data from neighboring counties
- Crop/pasture fractions within watershed used for partial counties
- States may submit animal fractions but not land use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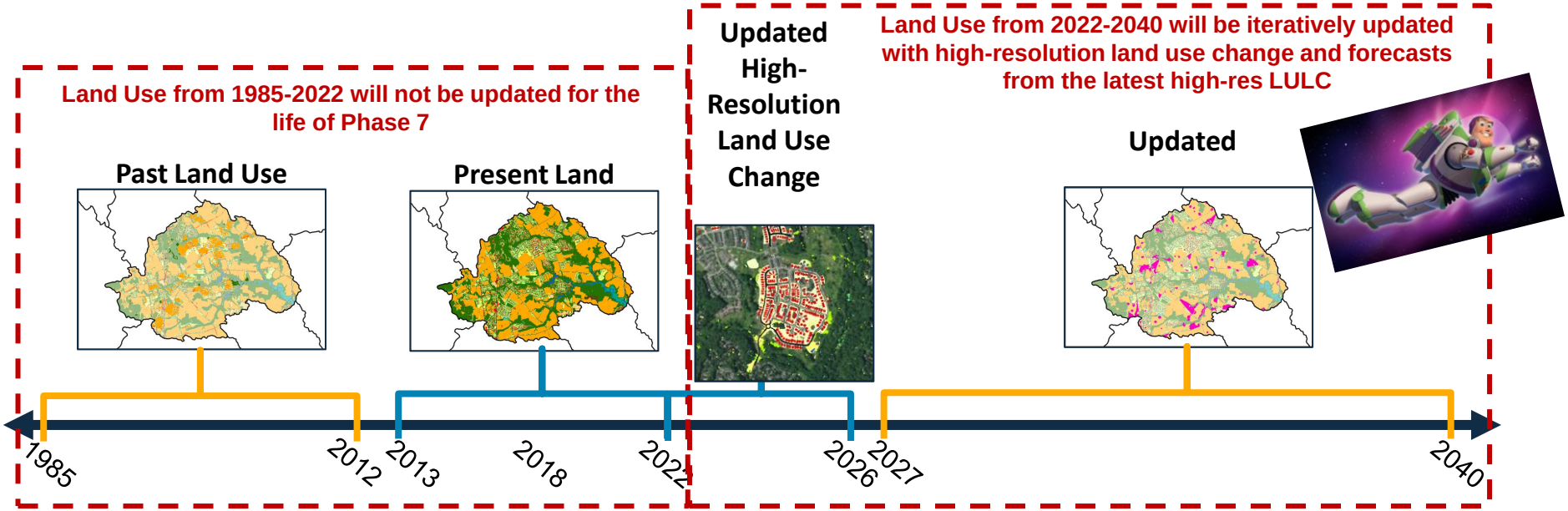
# Land Use Projection Beyond the Calibration Period




- Interpolation used for years beyond 2022
- Change product example:
  - 2035 adjustment =
    *2035 new – 2022 original* (by segment & agency)
  - applied to **CAST 2022 acres**
- Opportunity to evolve this method with explicit mapping of land use change (e.g. forest to developed)

# Best Management Practices

How BMPs are reported and applied to load sources

# CAST Phase 6 Agricultural Load Sources

**Cropland**

This category includes:

- Full Season Soybeans
- Double Cropped Land
- Silage with Manure
- Small Grains and Grains
- Grain without Manure
- Specialty Crop Low
- Other Agronomic Crops
- Grain with Manure
- Specialty Crop High

**Pasture**

This category includes:

- Ag Open Space
- Managed/Unmanaged Pasture & Hay

**Feeding Space**

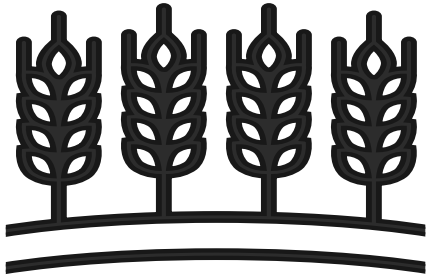
This category includes:

- Non-Permitted Feeding Space
- Permitted Feeding Space

CAST is an **average annual model** with land use representing what is in that calendar year

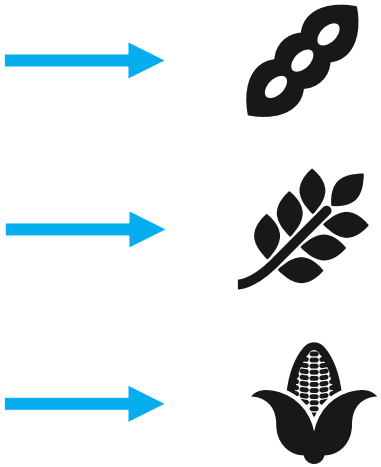
# BMP Reporting on Load Sources

BMPs are reported on either a **specific** or a **default** load source.

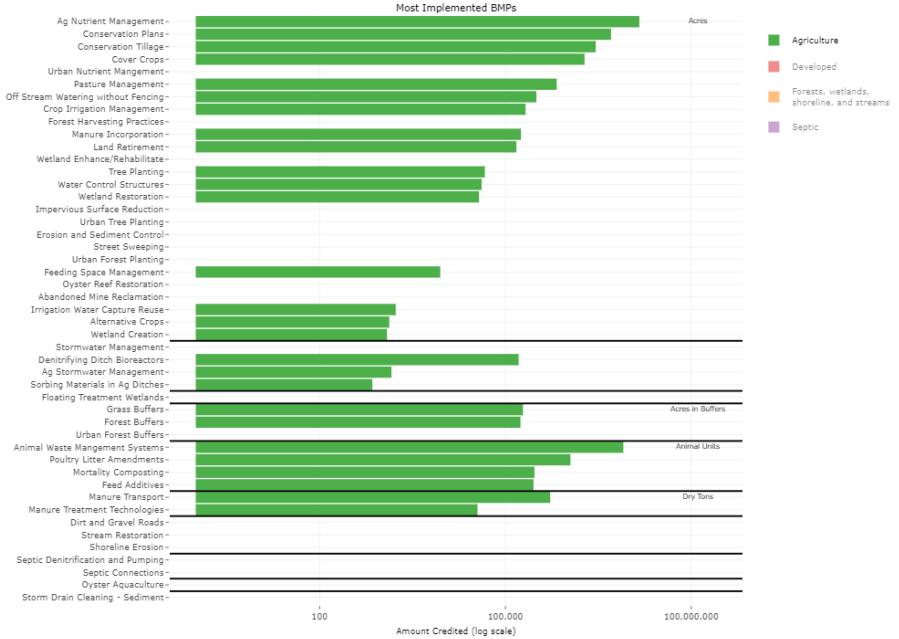


Agricultural BMP → Default Load Source → Specific Load Sources

BMPs that are reported on the default load source are then parsed out proportionally to the associated, specific load sources.



# Example BMPs




https://cast.chesapeakebay.net/Documentation/wipbmpcharts

**Common BMPs and their default/specific load sources:**

**Ag Nutrient Management – Row+Hay – 14 Load Sources:** Double Cropped Land, Full Season Soybeans, Grain with Manure, Grain without Manure, Hay, Leguminous Hay, Other Agronomic Crops, Other Hay, Pasture, Silage with Manure, Silage without Manure, Small Grains and Grains, Specialty Crop High, Specialty Crop Low

**Conservation Plans – Agricultural – 13 Load Sources:** Ag Open Space, Double Cropped Land, Full Season Soybeans, Grain with Manure, Grain without Manure, Leguminous Hay, Other Agronomic Crops, Other Hay, Pasture, Silage with Manure, Small Grains and Grains, Specialty Crop High, Specialty Crop Low

**Conservation Tillage – Row – 10 Load Sources:** Double Cropped Land, Full Season Soybeans, Grain with Manure, Grain without Manure, Other Agronomic Crops, Silage with Manure, Silage without Manure, Smalls Grains and Grains, Specialty Crop High, Specialty Crop Low

# Questions to Consider

- What load sources do we need for BMP reporting in Phase 7?
- What level of detail can jurisdictions track?
- What can the data reporters report?

# Resources

- Land Uses
  - https://www.chesapeakebay.net/who/group/land-use-workgroup
  - https://d18lev1ok5leia.cloudfront.net/chesapeakebay/documents/SRS_MB_LUMM_02_11_21_Final.pdf
  - https://www.chesapeakebay.net/files/documents/WQGIT_Phase7Rollup_20250428_S.McDonald.pdf

- CAST Load Sources
  - https://cast.chesapeakebay.net/Home/SourceData

- Example BMPs
  - https://cast.chesapeakebay.net/Documentation/wipbmpcharts
  - https://cast.chesapeakebay.net/Home/TmdlTracking#progressReportingSection

# Thank you!

Any questions?
You can contact me at
helen@devereuxconsulting.com

Chesapeake Bay Program
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