CLT Continued Aircraft Operations Evaluations

Airport Community Roundtable Presentation

January 16, 2019

ACR Requests of the CLT Technical Consultant

- HMMH status of current ACR motions and requests
- Altitude based departure turns – *additional analysis*
  - Continuation of prior analysis of altitude based turns at ***2,500 feet*** above Mean Sea Level (MSL)
    - To include number of events above maximum sound level (Lmax) of 70 dB (N70) in the grid analyses
  - Additional analysis of altitude based turns at ***3,000 and 3,500 feet*** MSL
    - Lmax grid analyses
    - N70 grid analysis
  - Altitude based turn analysis conclusions based on the Lmax and N70 grid analysis results

HMMH Status of Current ACR Motions and Requests

Status of ACR Motions involving the CLT Technical Consultant to-Date

Date	Motion #	Motion	ACR Status	HMMH Status
11/17/2017	01-17	FAA to examine CDA/OPD routes at CLT	ONGOING	***Complete:*** HMMH presented a potential design for CDA/OPD Runway 36L approach at 2018 August ACR meeting and associated noise analyses
11/17/2017	N/A	North Flow Downwind Altitude	UPDATED IN MOTION 06-18	***Complete:*** HMMH analyzed altitudes of the North Flow East Downwind and presented results at the 2018 July, August, September, and October ACR meetings
2/21/2018	00-18	RWY 18L Departure turnout delay	UPDATED IN MOTION 04-18	***Ongoing:*** HMMH analyzed delaying Runway 18L departure turns as part of the analyses and presented at the 2018 July and August ACR meetings
3/21/2018	01-18/02-18	Request to raise Minimum Altitude on Arrival	CLOSED	***Complete:*** HMMH presented analyses of increasing base leg altitudes for CLT arrivals during the 2018 July, August, and September ACR meetings
4/18/2018	03-18	Slow the departure speed	PENDING FURTHER REVIEW	***Awaiting progress by industry:*** HMMH provided details on the experimental phase of slowing aircraft departure speeds at the 2018 July ACR meeting
5/16/2018	04-18	RWY 18L Departure turnout delay/Intermediate Heading	UPDATED IN MOTION 05-18	***Ongoing:*** HMMH analyzed delaying Runway 18L departure turns as part of the analyses and presented at the 2018 July and August ACR meetings as well as the altitude based turn analyses presented at the 2018 September, October, and December ACR meetings

Status of ACR Requests of the CLT Technical Consultant to-Date (1 of 3)

Date	Request #	Request	ACR Status	HMMH Status
8/15/2018	05-18	Request to study multi-path RNAV departures routes to the Southwest	PENDING FURTHER REVIEW	***Ongoing:*** HMMH provided details on multiple path RNAV departures at the 2018 September ACR meeting as well as discussed other methods of dispersing departures as part of the altitude-based turn and divergent heading analyses presented at the 2018 September, October, and December ACR meetings
8/15/2018	37	Look at profiles of departing airlines	Complete	***Complete:*** HMMH presented noise information on airline and airport departure profiles at the 2018 September and October ACR meetings
8/15/2018	38	Look at departure profiles at other airport	Complete	***Complete:*** HMMH presented noise information on airline and airport departure profiles at the 2018 September and October ACR meetings
7/18/2018	40	On South Departures, delay Turns off 18L (East) and 18C (West)	In Progress	***Ongoing – presenting results tonight:*** HMMH analyzed delaying Runway 18L departure turns as part of the analyses and presented at the 2018 July and August ACR meetings as well as the altitude based turn analyses presented at the 2018 September, October, and December ACR meetings
7/18/2018	41	On South Departures, change heading at first turns off 18L (East) and 18C (West)	In Progress	***Ongoing:*** HMMH analyzed changing Runway 18L and 18C departure headings as part of the divergent heading analyses presented at the 2018 December ACR meeting
7/18/2018	42	Analyze Viability/Benefit of Multiple Headings on South Departures	In Progress	***Ongoing:*** HMMH analyzed the feasibility of multiple Runway 18L and 18C departure headings as part of the divergent heading analyses presented at the 2018 December ACR meeting

Status of ACR Requests of the CLT Technical Consultant to-Date (2 of 3)

Date	Request #	Request	ACR Status	HMMH Status
7/18/2018	43	Analyze Viability/Benefit of Multiple Paths on Arrivals	In Progress	***Ongoing:*** HMMH analyzed the feasibility of multiple Runway 36L, 36C and 36R downwind legs as part of the alternating downwind analyses presented at the 2018 December ACR meeting
7/18/2018	44	Analyze Viability/Benefit of Increasing use of OPDs	In Progress	***Completed:*** HMMH presented a potential design for CDA/OPD Runway 36L approach at 2018 August ACR meeting and associated noise analyses
9/19/2018	48	More information on moving Downwind – Follow up to 7/18/18 Request for analysis of Multiple Paths on Arrivals	In Progress	***Ongoing:*** HMMH analyzed the feasibility of multiple Runway 36L, 36C and 36R downwind legs as part of the alternating downwind analyses presented at the 2018 December ACR meeting
10/24/2018	N/A	Conduct additional analysis of the Altitude-based Turns concept shared at the 9/19/18 meeting. This additional analysis would assess effects of Altitude-based Turns, including three key factors: Noise, Throughput, Population	No Status	***Ongoing – presenting results tonight:*** HMMH presented additional altitude based turn analyses at the 2018 December ACR meeting
10/24/2018	N/A	Assessment of the feasibility of divergent headings (possibly have HMMH/FAA discuss options, particularly anything more controllable locally)	No Status	***Ongoing:*** HMMH presented analyses of the feasibility of implementing divergent headings at the 2018 December ACR meeting
10/24/2018	N/A	Analyze the Noise Abatement Profile (NADP 1) v. the Normal Takeoff Profile (NADP 2) v. the Standard Takeoff Profile. Focus analysis using A321, CRJ9, and A319 – higher volume AA aircraft	No Status	***Ongoing – awaiting profiles from American Airlines:*** HMMH presented additional noise analyses for the Standard, NADP1, and NADP2 departure profiles using A321, CRJ9, and A319 aircraft at the 2018 December ACR meeting

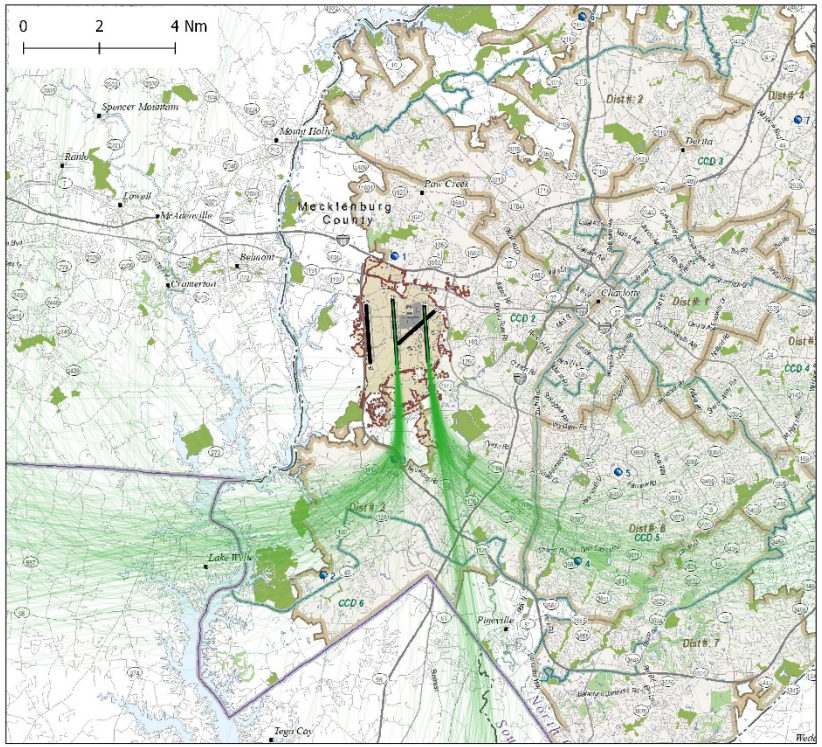
Status of ACR Requests of the CLT Technical Consultant to-Date (3 of 3)

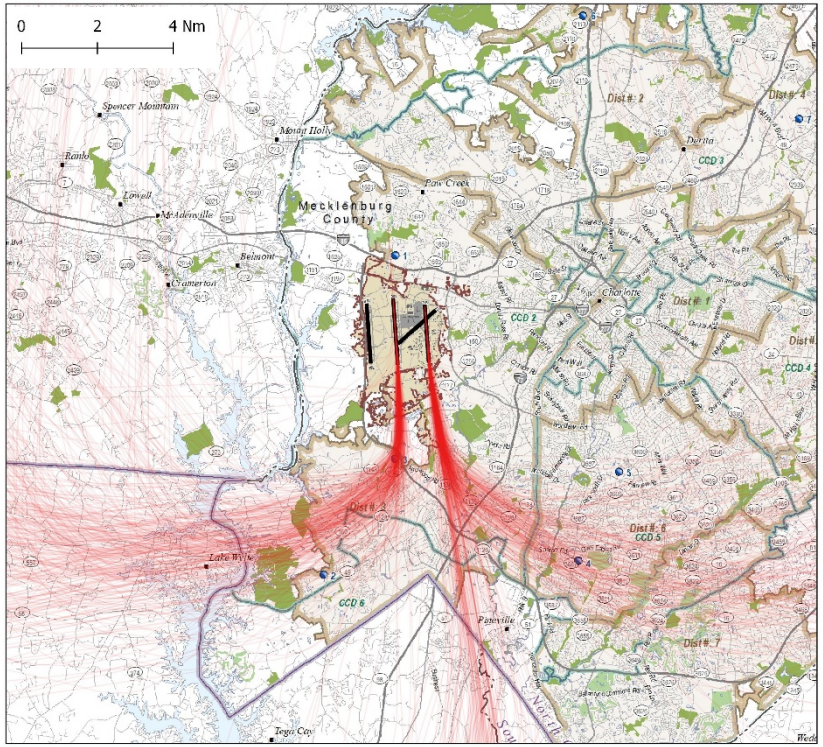
Date	Request #	Request	ACR Status	HMMH Status
10/24/2018	N/A	Study the feasibility of moving the arrival rails every year by a distance of X mile(s) for as many years as possible before repeating the same rail. This change in procedure would affect the people underneath every X number of years giving them X years without arrival noise pollution.	No Status	***Ongoing:*** HMMH analyzed the feasibility of multiple Runway 36L, 36C and 36R downwind legs as part of the alternating downwind analyses presented at the 2018 December ACR meeting
12/19/2018	N/A	Present number of aircraft operations in a grid to determine effect on dispersion. Conduct the analysis at 3,000' and 3,500' to compare to the December 2,500' analysis. Incorporate seasonality into the analysis to take weather changes, in particular, into account. Have as a point of analysis the effect on airfield capacity.	No Status	***Ongoing – presenting results tonight:*** HMMH to present additional ongoing requested analyses at January 2019 ACR meeting. Future analyses will address seasonality and airport capacity
12/19/2018	N/A	Requested that American Airlines (AA) provide CLT departure procedures so that more specific analysis could be performed on the effects of different Departure Profiles on noise in the community.	No Status	***Awaiting delivery of profiles:*** HMMH coordinating with American Airlines (AA) to obtain departure profiles and present analyses results at a future ACR meeting

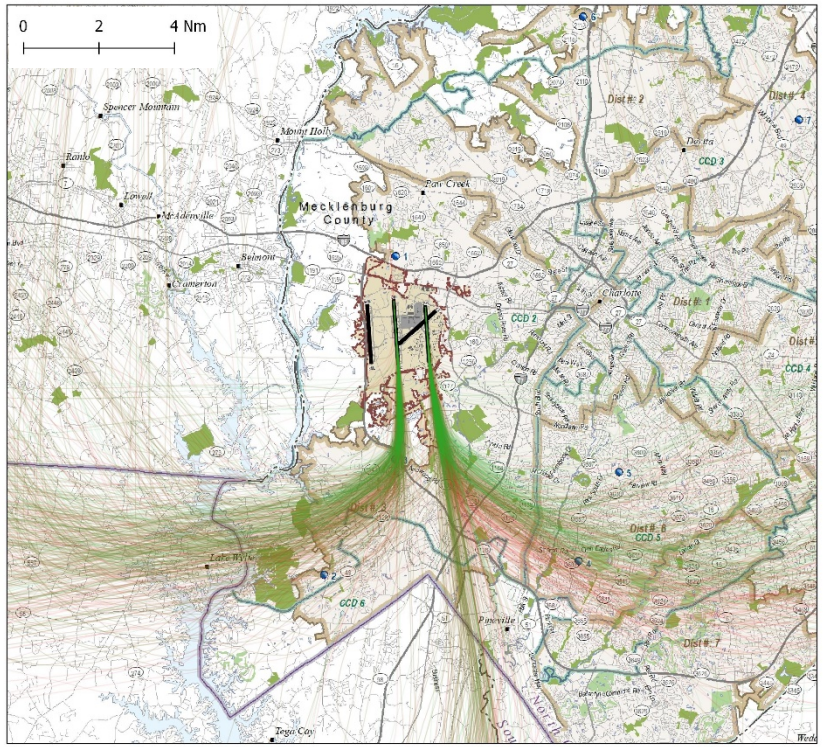
Altitude Based Turns at 2,500 feet MSL

Continuation of analysis presented at October and December 2018 ACR meetings

South Flow Departures - Modified Flight Tracks with 2,500 feet MSL Altitude Based Turn Compared to Original (April 6, 2018)



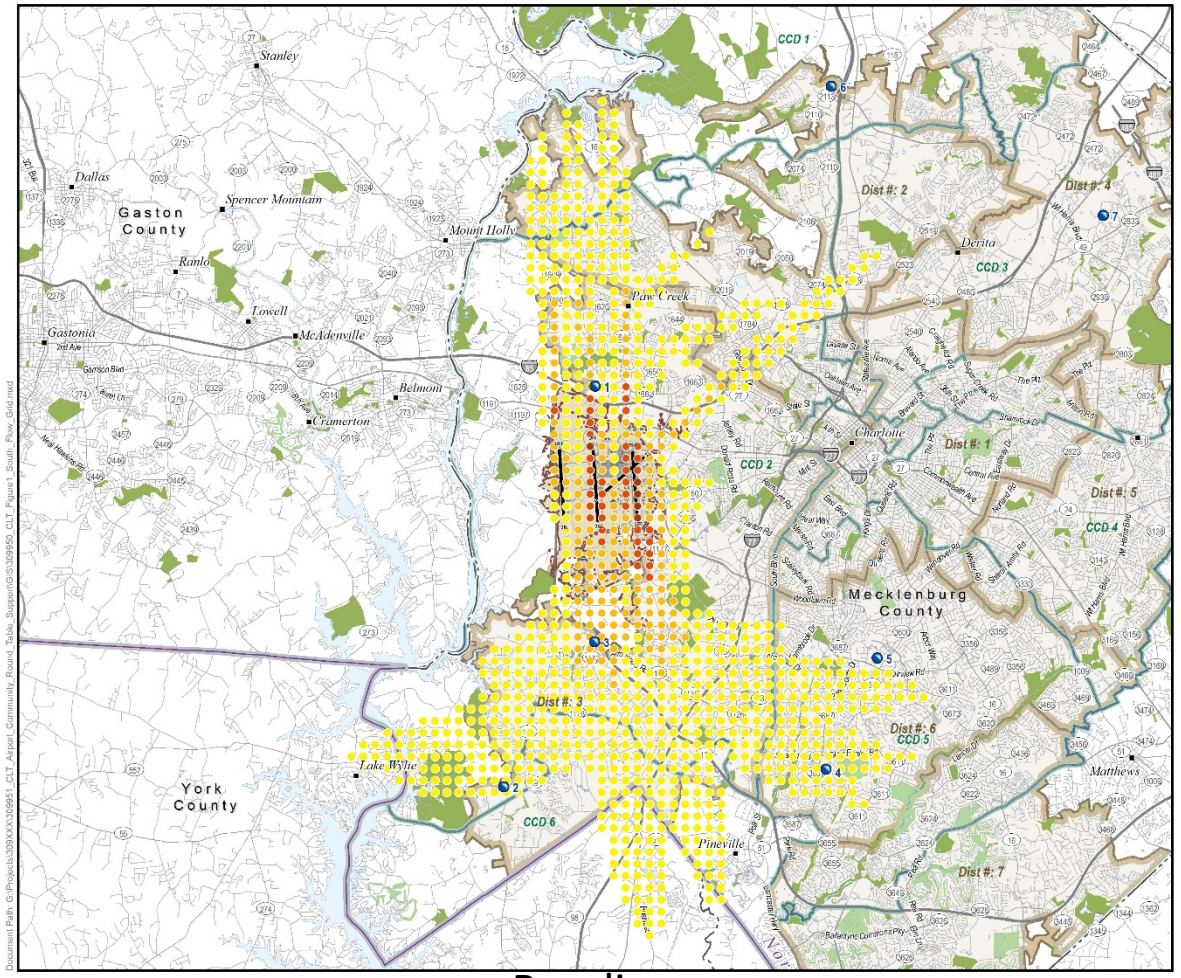




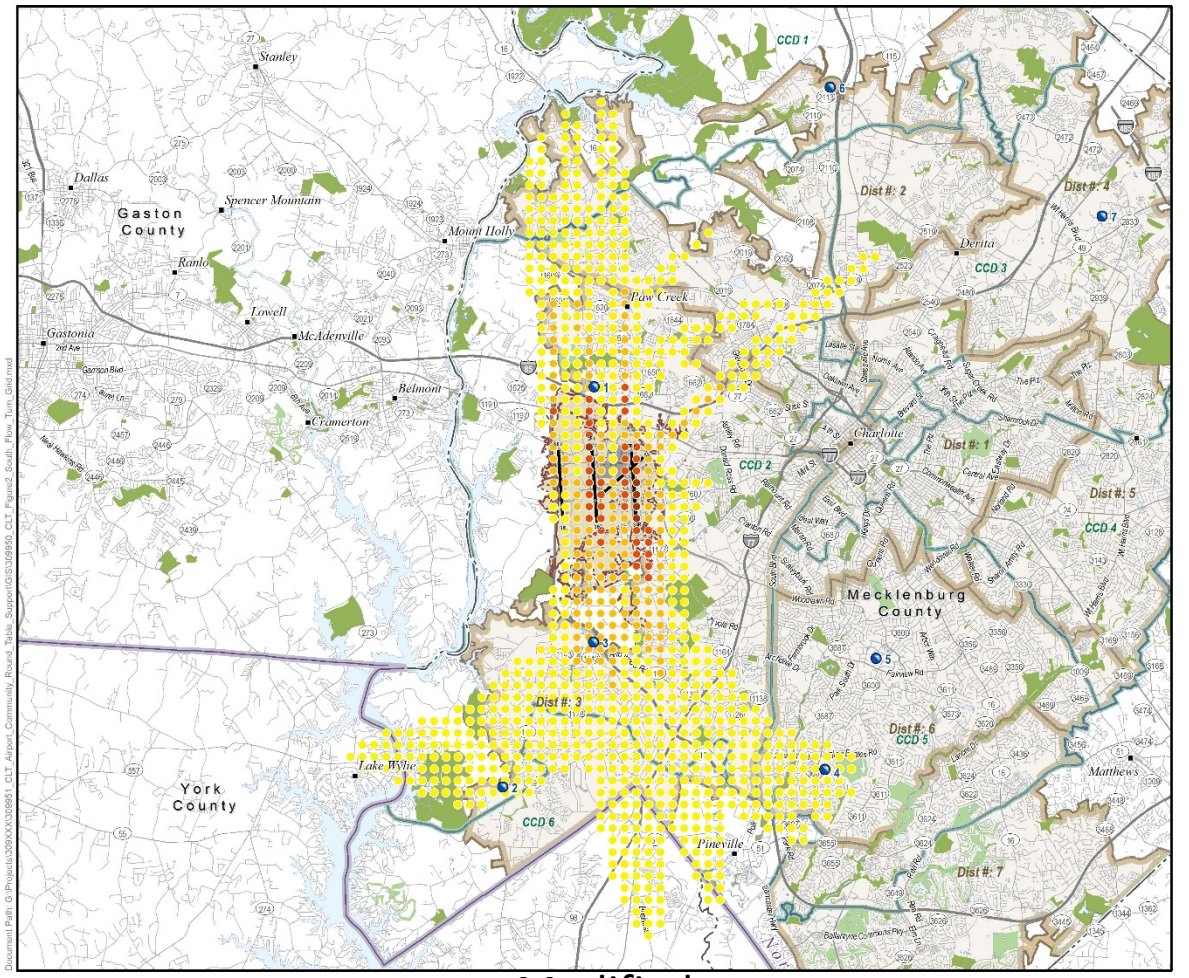
Legend

- Runways
- 2018 South Flow Departures
- Potential Tracks on a 2,500ft Altitude Based Turn
- State Boundary
- Highway
- Major Roads
- Park / Open Space
- County Boundary
- Minor Roads
- Railroad
- Water
- Landmark Locations
  1. West Mecklenburg High
  2. Southwest Middle School
  3. Olympic Community High School
  4. Quail Hollow Middle School
  5. South Park Mall
  6. NorthLake Mall
  7. UNCC
- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

Noise Analysis (Lmax 70 dB and greater) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 2,500 feet MSL

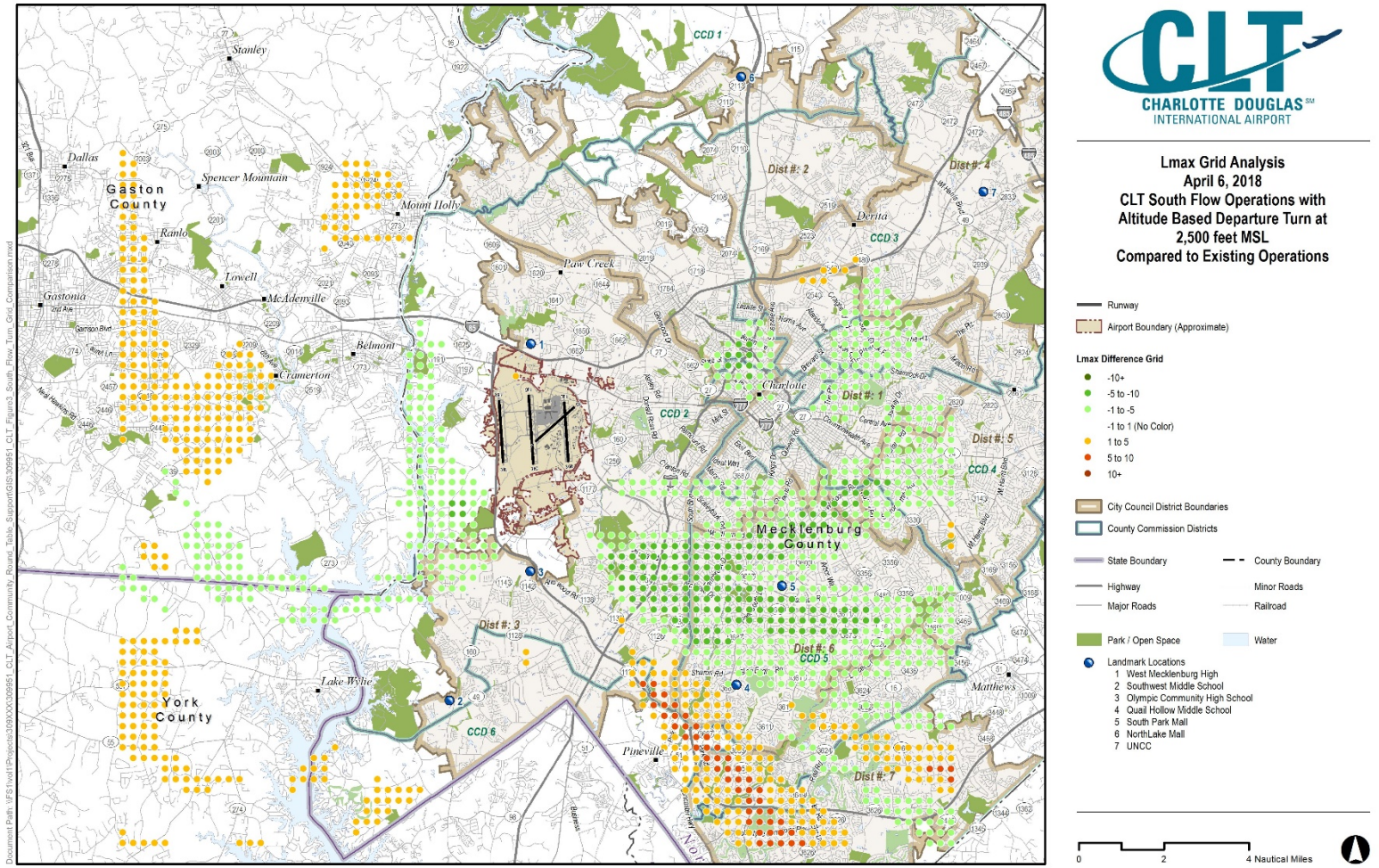


Baseline



Modified

Areas of Change in Noise Levels of 2,500 feet MSL Altitude Based Turns Compared to Unmodified Departures



CLT
CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Lmax Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 2,500 feet MSL Compared to Existing Operations

- Runway
- Airport Boundary (Approximate)

Lmax Difference Grid

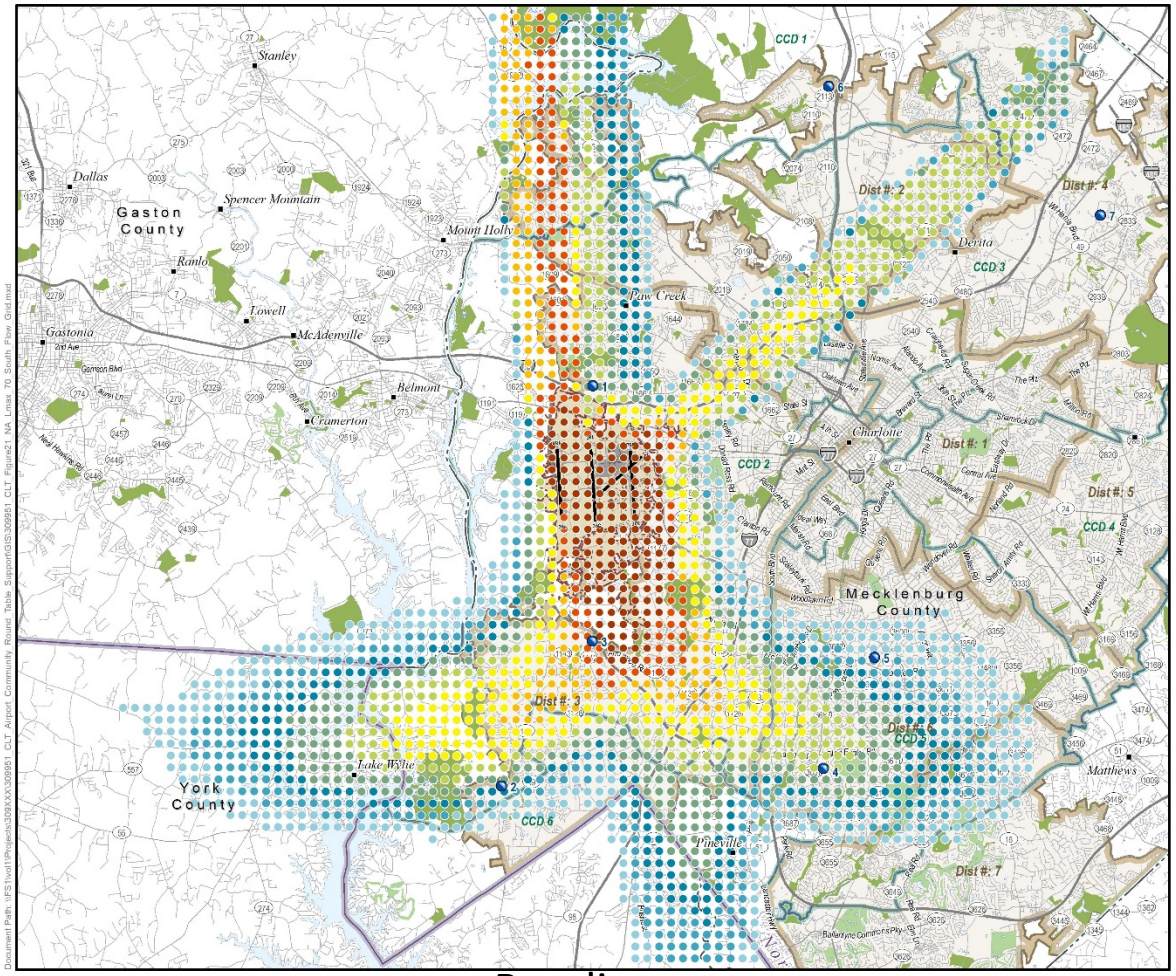
- -10+
- -5 to -10
- -1 to -5
- -1 to 1 (No Color)
- 1 to 5
- 5 to 10
- 10+

- City Council District Boundaries
- County Commission Districts
- State Boundary
- County Boundary
- Highway
- Minor Roads
- Major Roads
- Railroad
- Park / Open Space
- Water

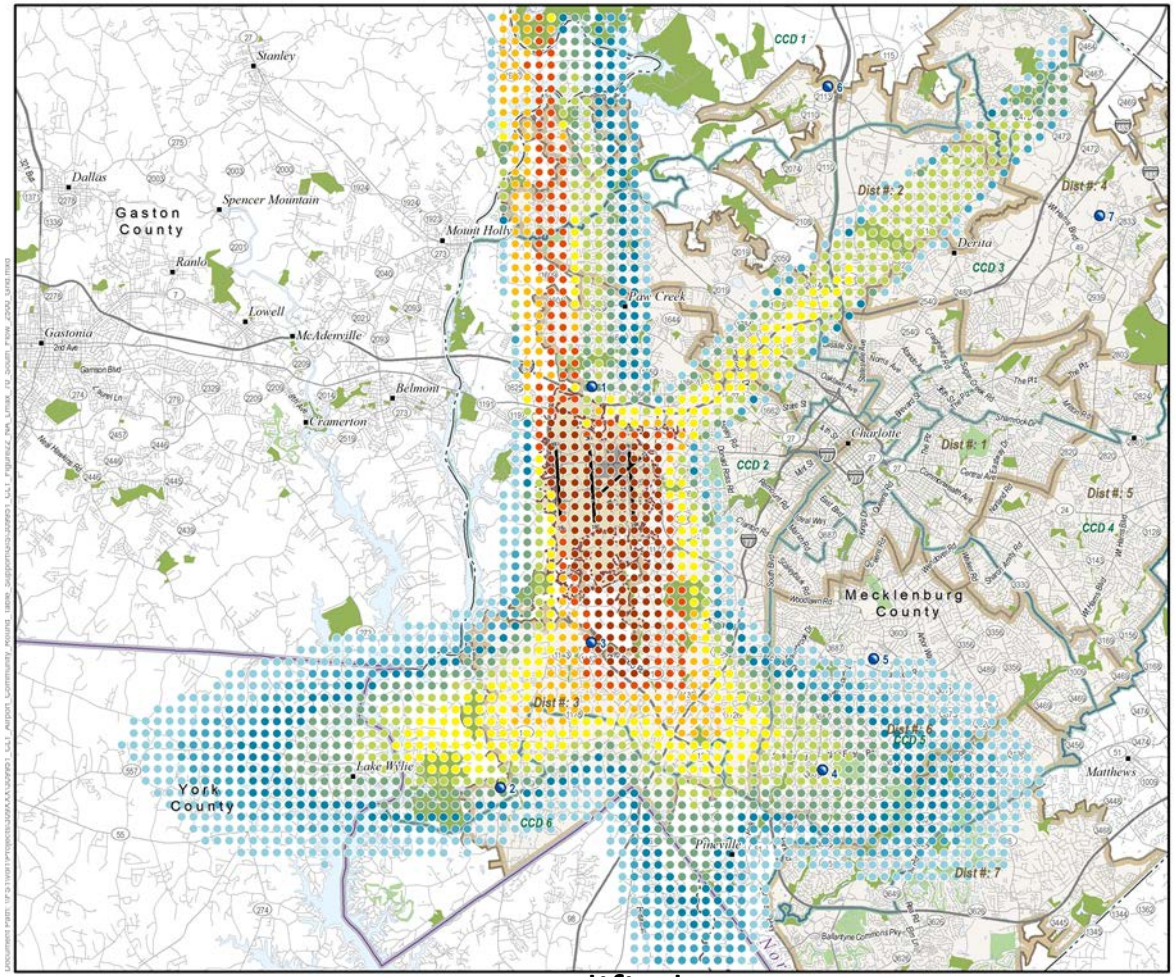
Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

0 2 4 Nautical Miles

Number of Events Analysis (N70) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 2,500 feet MSL

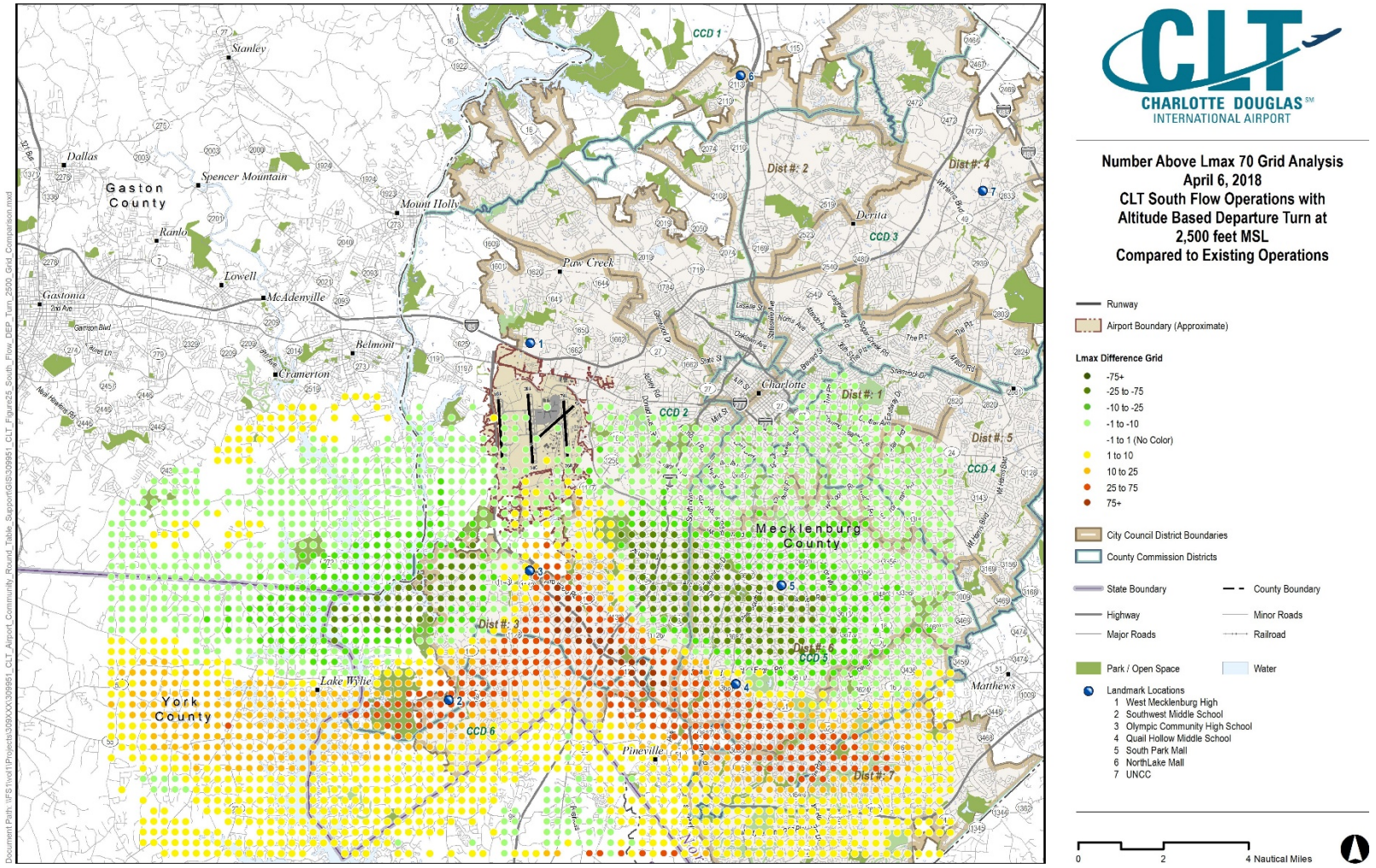


Baseline



Modified

Areas of Change in Number of Events of 2,500 feet MSL Altitude Based Turns Compared to Unmodified Departures



CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Number Above Lmax 70 Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 2,500 feet MSL
Compared to Existing Operations

- Runway
- Airport Boundary (Approximate)

Lmax Difference Grid

- -75+
- -25 to -75
- -10 to -25
- -1 to -10
- -1 to 1 (No Color)
- 1 to 10
- 10 to 25
- 25 to 75
- 75+

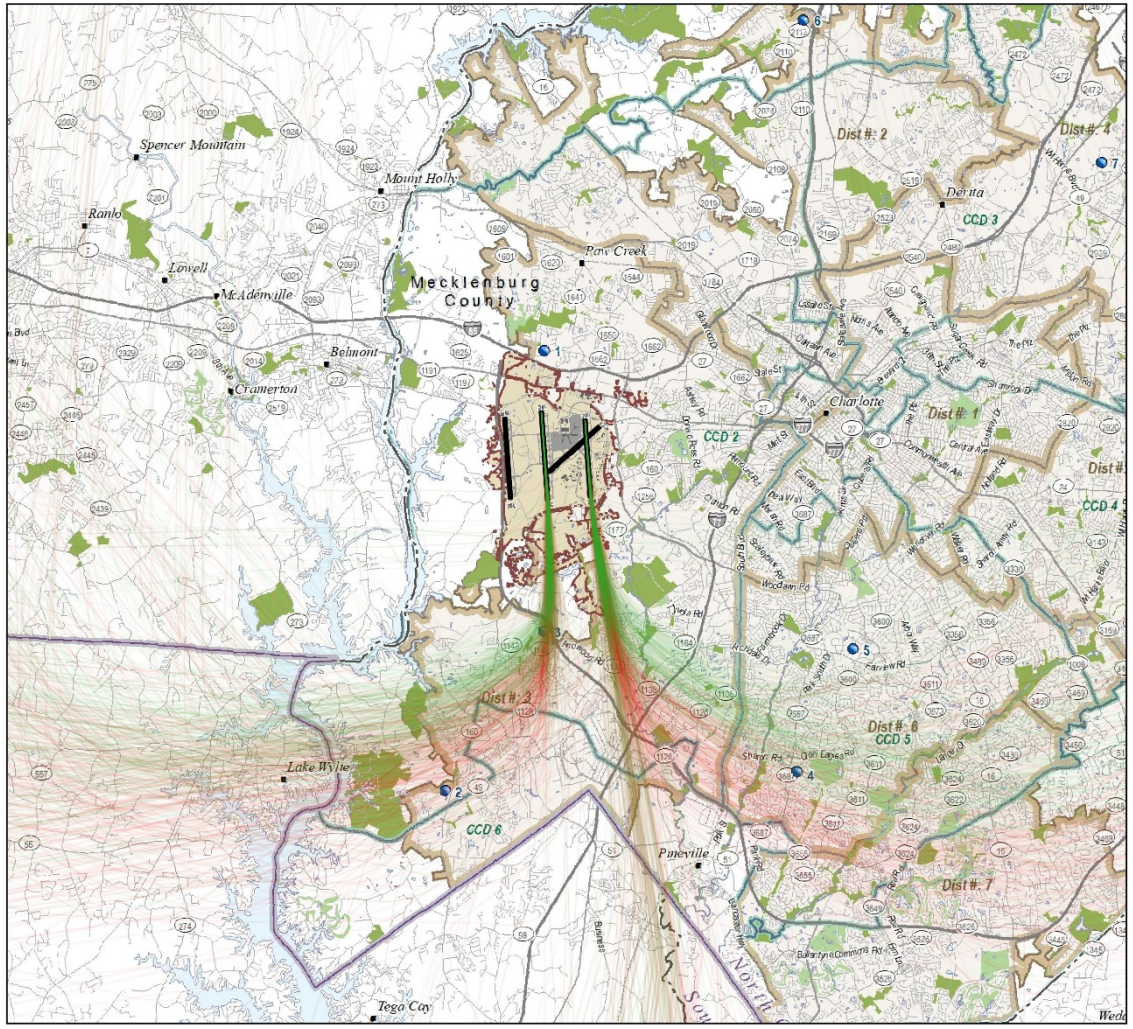
- City Council District Boundaries
- County Commission Districts
- State Boundary
- County Boundary
- Highway
- Minor Roads
- Major Roads
- Railroad
- Park / Open Space
- Water

Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

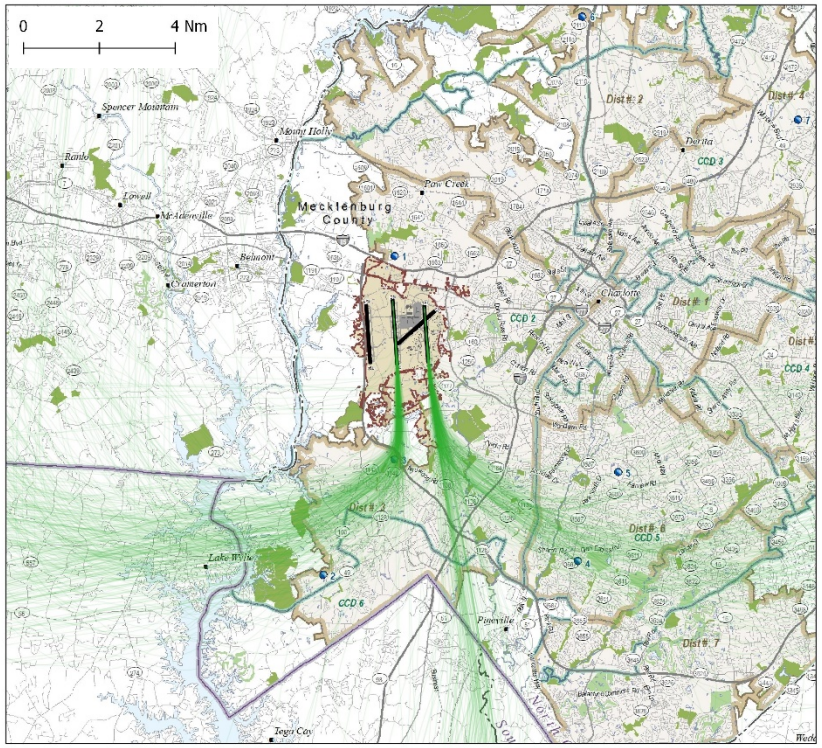
0 2 4 Nautical Miles

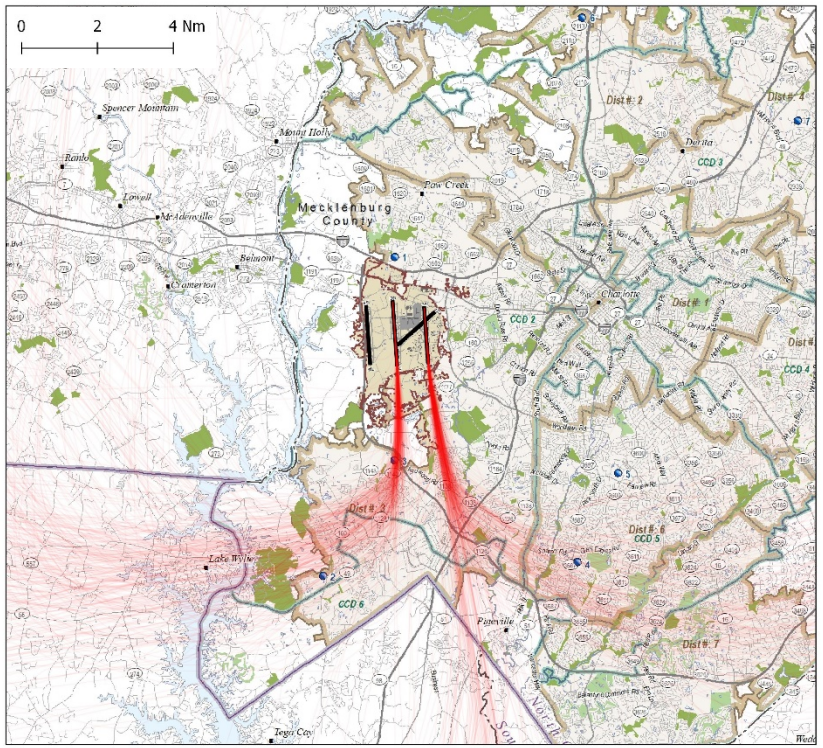
Altitude Based Turns at 3,000 feet MSL

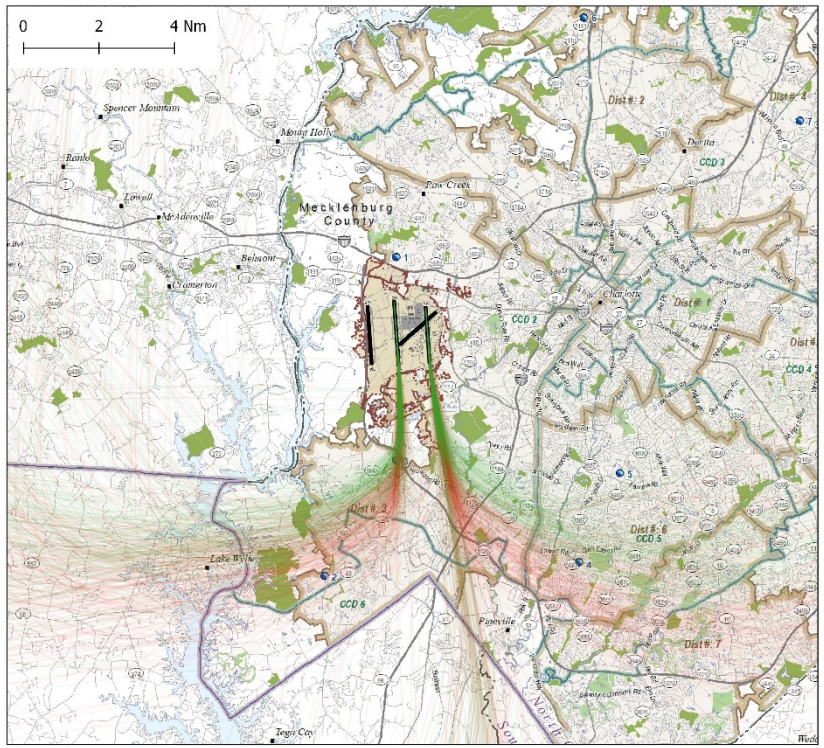
Additional analysis requested by the ACR



South Flow Departures - Modified Flight Tracks with Turns at 3,000 feet MSL Compared to Original (April 6, 2018)







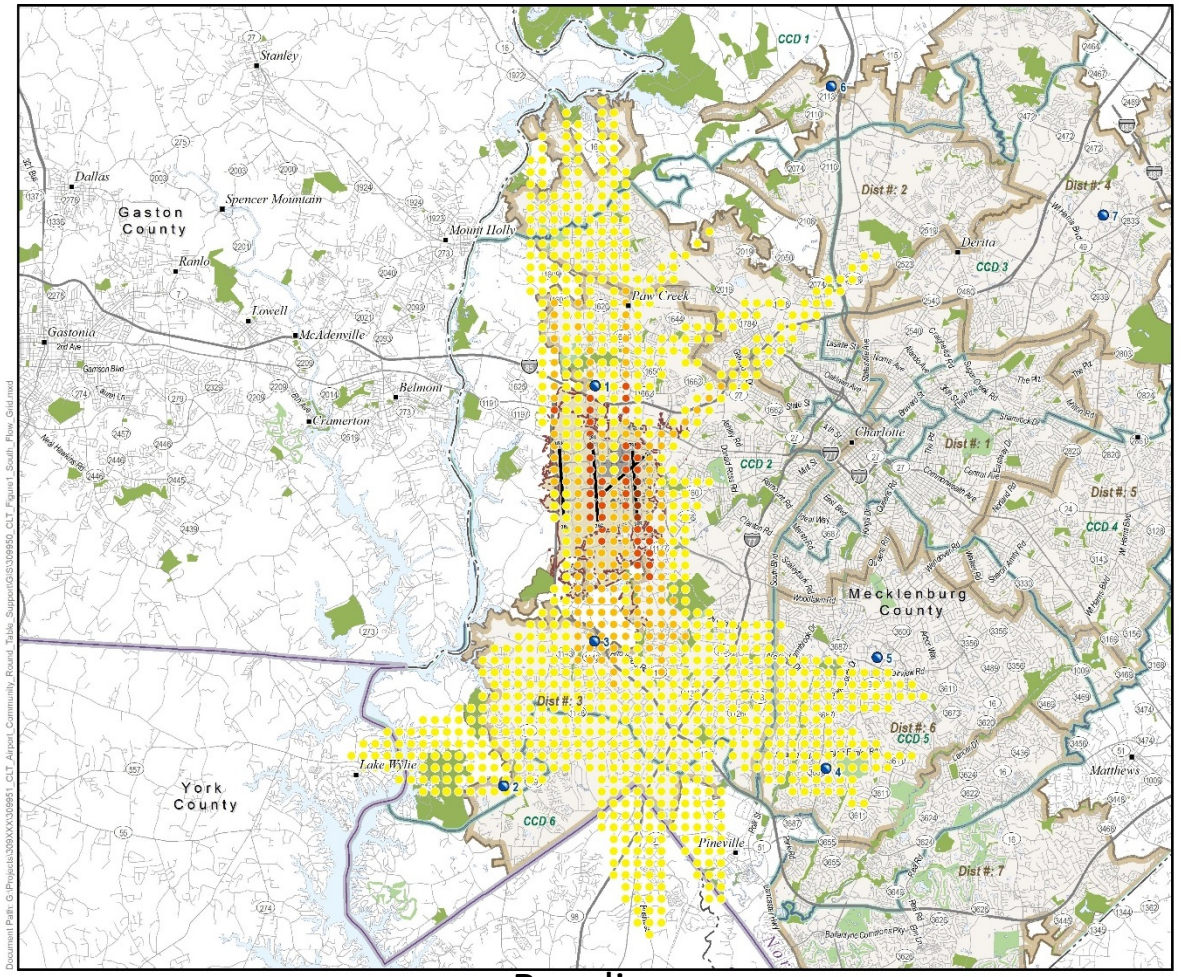
Legend

- Runways
- 2018 South Flow Departures
- Potential Tracks on a 3,000ft Altitude Based Turn
- State Boundary
- Highway
- Major Roads
- Park / Open Space
- County Boundary
- Minor Roads
- Railroad
- Water

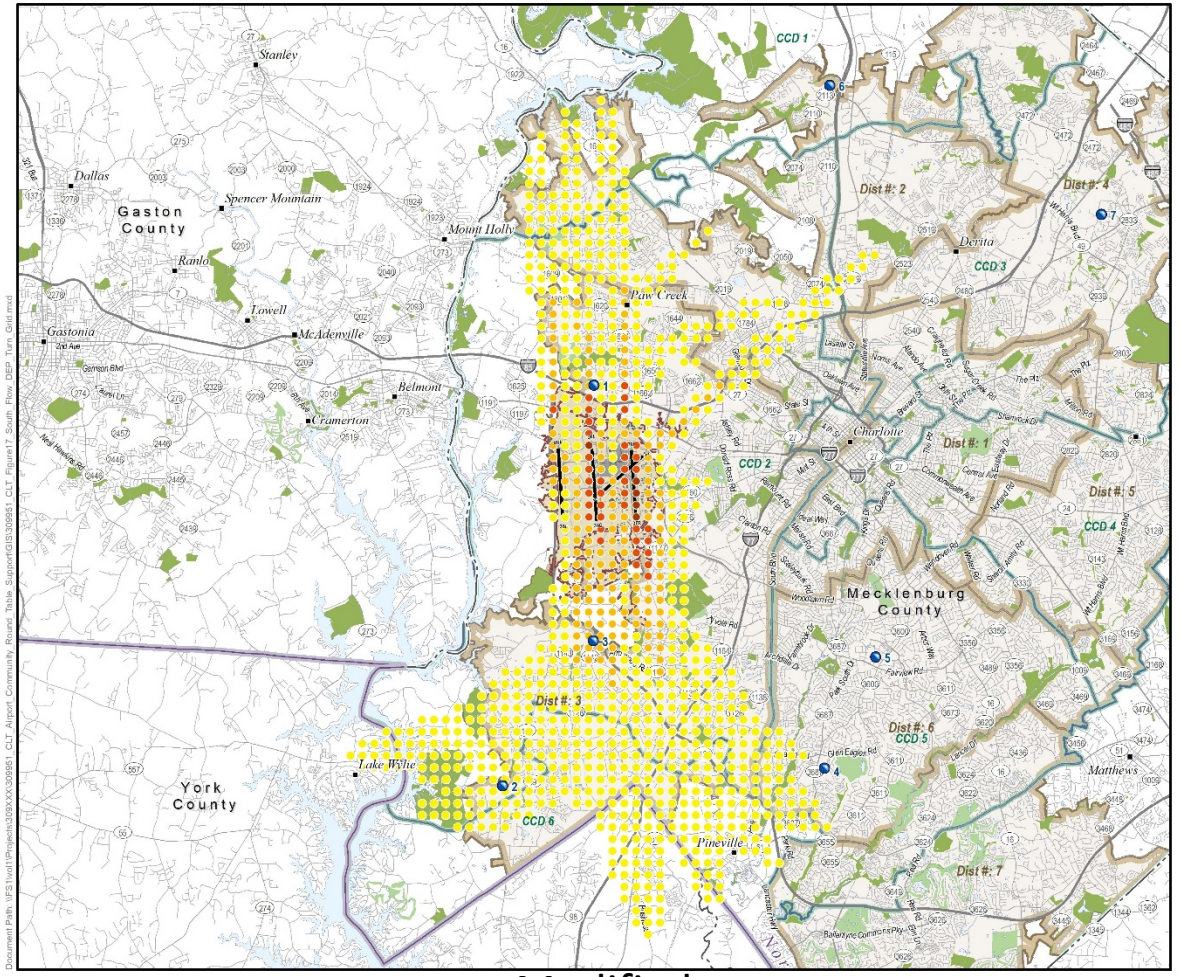
Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

Noise Analysis (Lmax 70 dB and greater) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 3,000 feet MSL

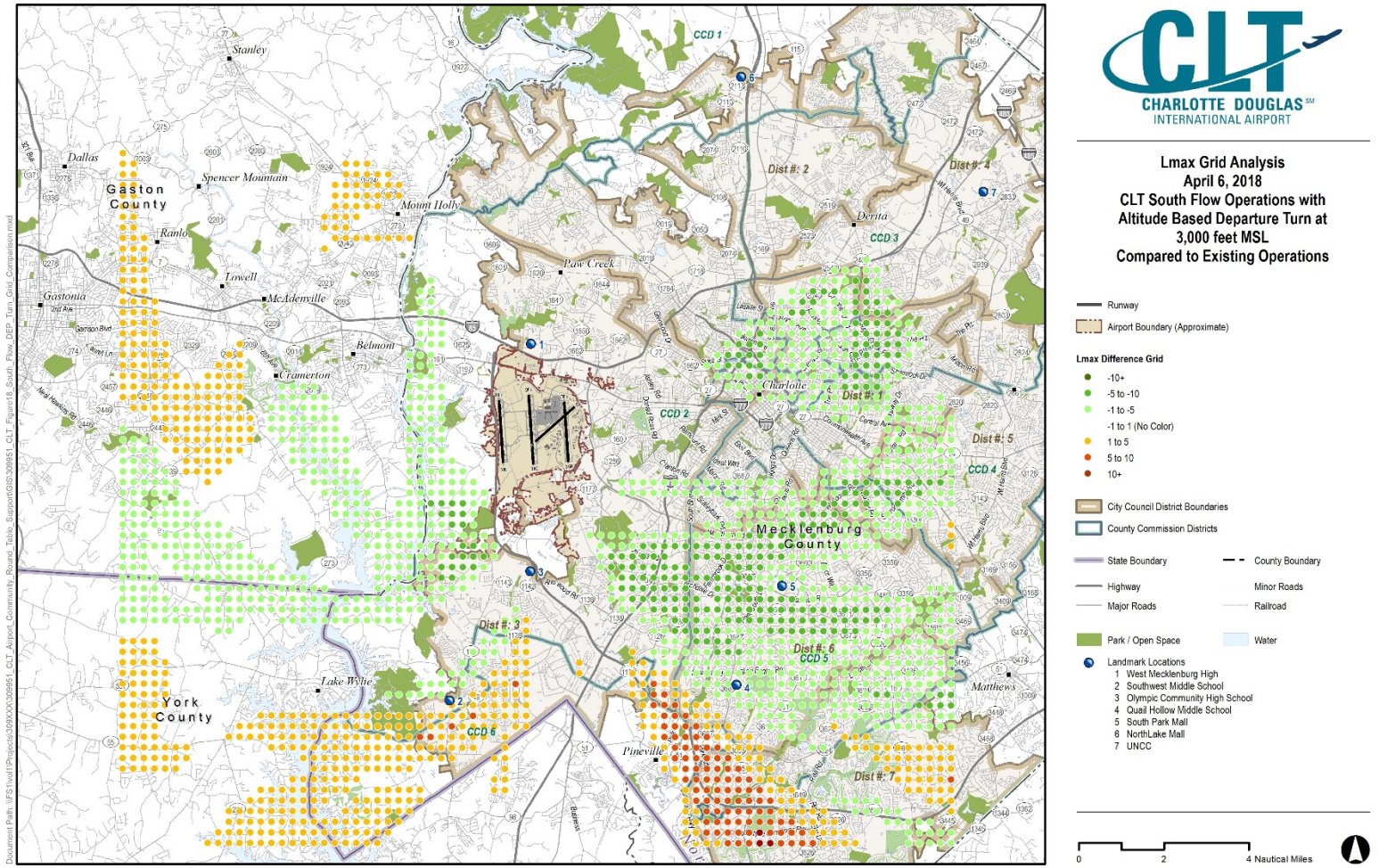


Baseline



Modified

Areas of Change in Noise Levels of 3,000 feet MSL Altitude Based Turns Compared to Unmodified Departures



CLT CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Lmax Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 3,000 feet MSL
Compared to Existing Operations

- Runway
- Airport Boundary (Approximate)

Lmax Difference Grid

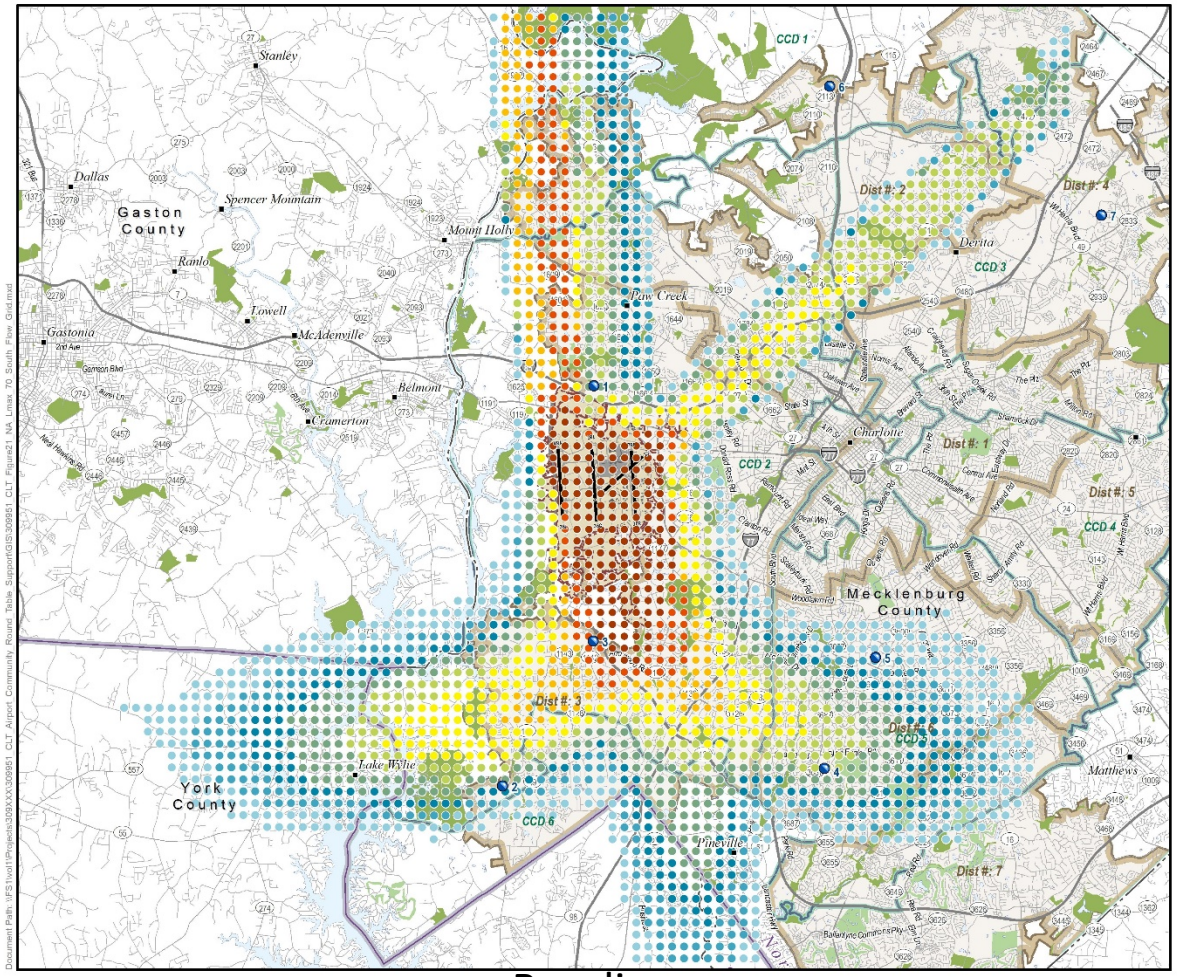
- -10+
- -5 to -10
- -1 to -5
- -1 to 1 (No Color)
- 1 to 5
- 5 to 10
- 10+

- City Council District Boundaries
- County Commission Districts
- State Boundary
- County Boundary
- Highway
- Minor Roads
- Major Roads
- Railroad
- Park / Open Space
- Water

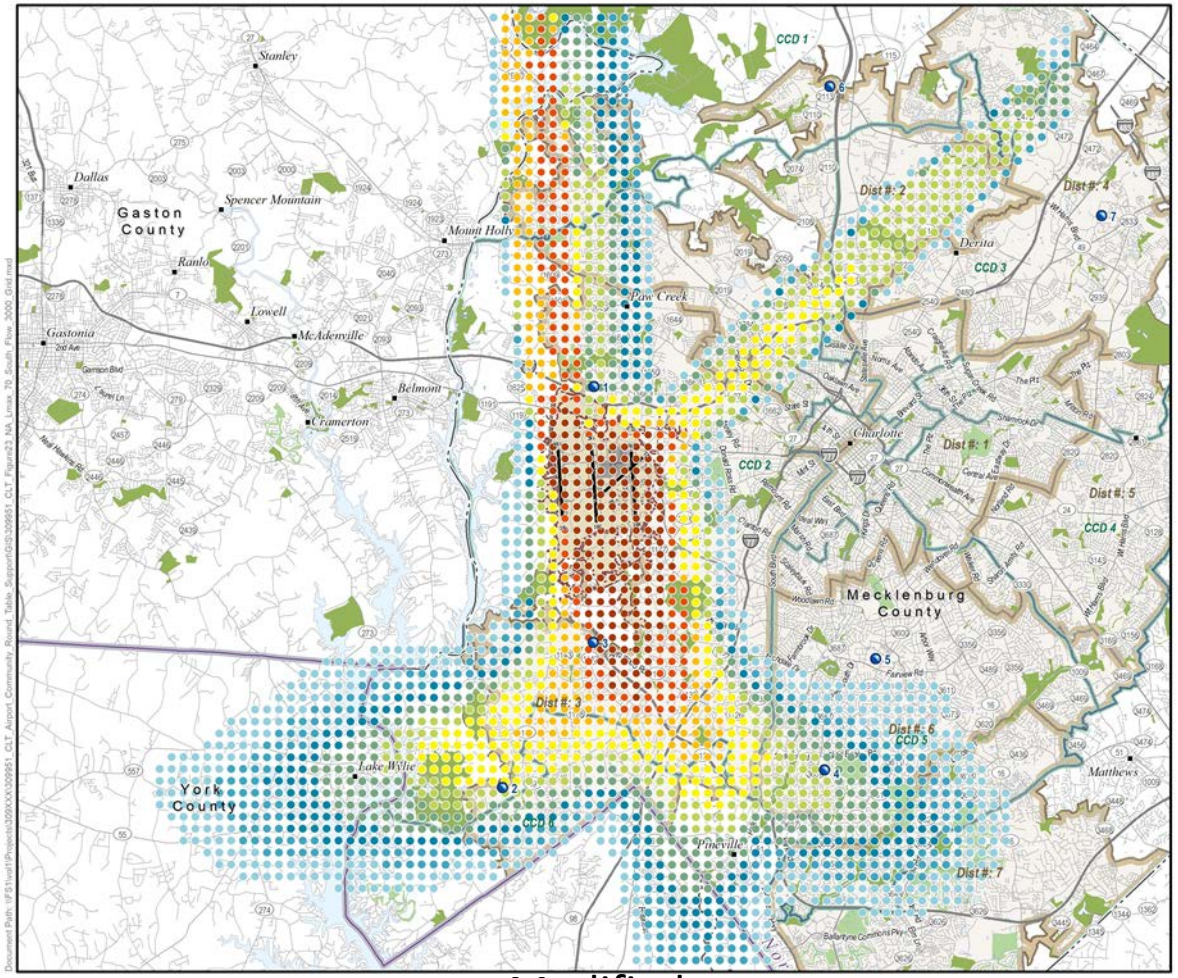
Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

0 2 4 Nautical Miles

Number of Events Analysis (N70) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 3,000 feet MSL

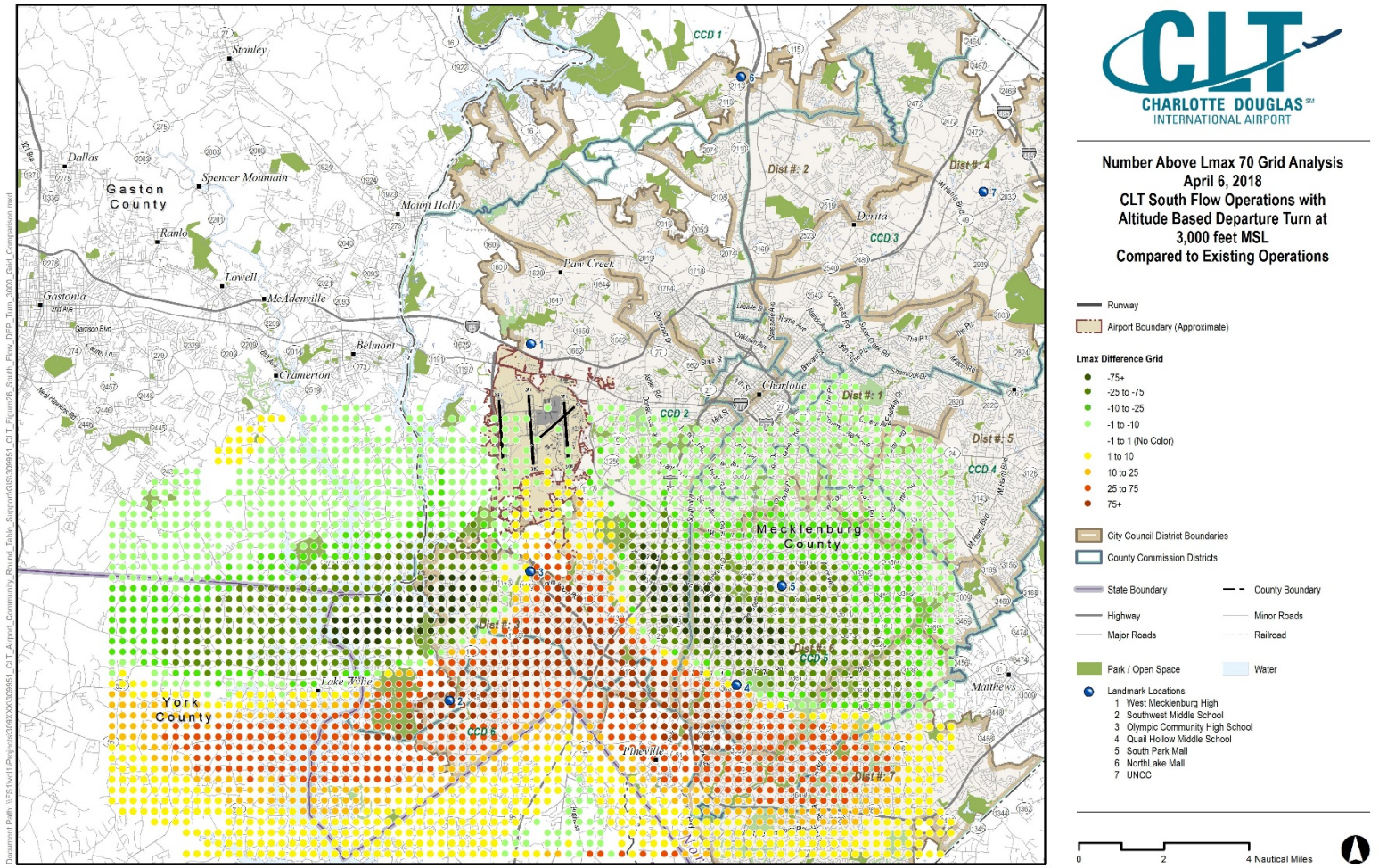


Baseline



Modified

Areas of Change in Number of Events of 3,000 feet MSL Altitude Based Turns Compared to Unmodified Departures



CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Number Above Lmax 70 Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 3,000 feet MSL
Compared to Existing Operations

Runway
Airport Boundary (Approximate)

Lmax Difference Grid
- -75+
- -25 to -75
- -10 to -25
- -1 to -10
- -1 to 1 (No Color)
- 1 to 10
- 10 to 25
- 25 to 75
- 75+

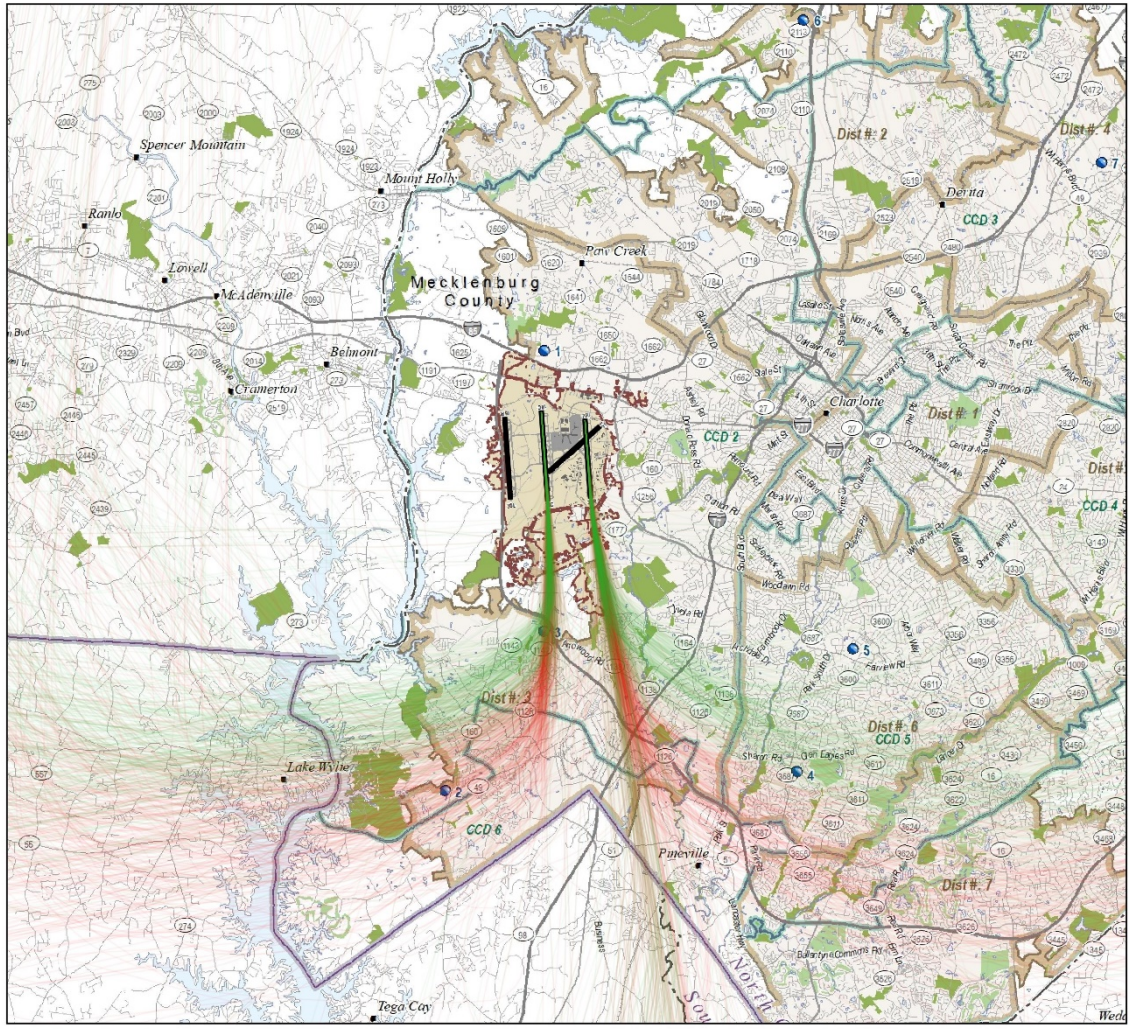
City Council District Boundaries
County Commission Districts
State Boundary
County Boundary
Highway
Minor Roads
Major Roads
Railroad
Park / Open Space
Water

Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

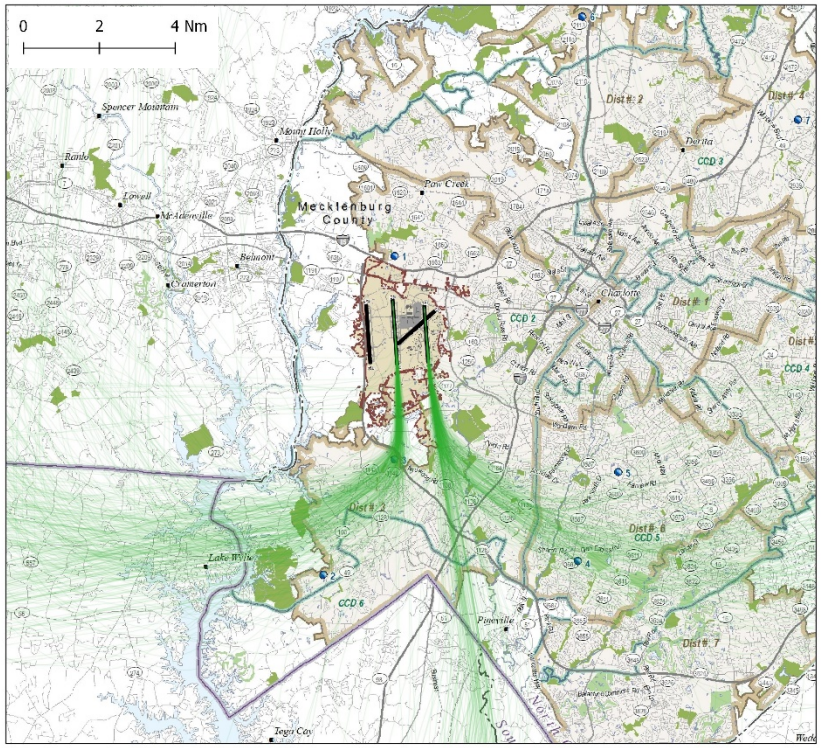
0 2 4 Nautical Miles

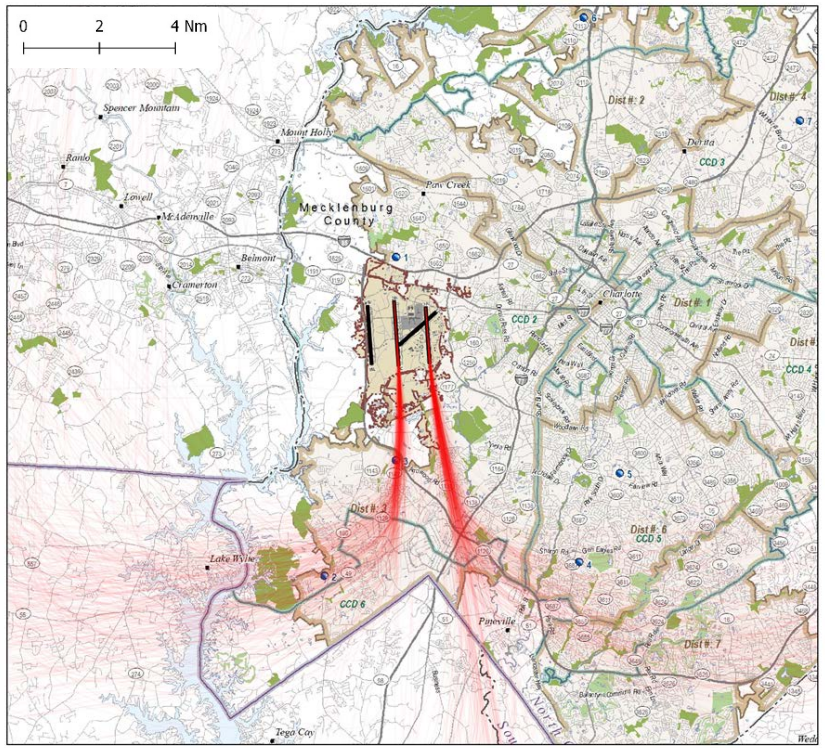
Altitude Based Turns at 3,500 feet MSL

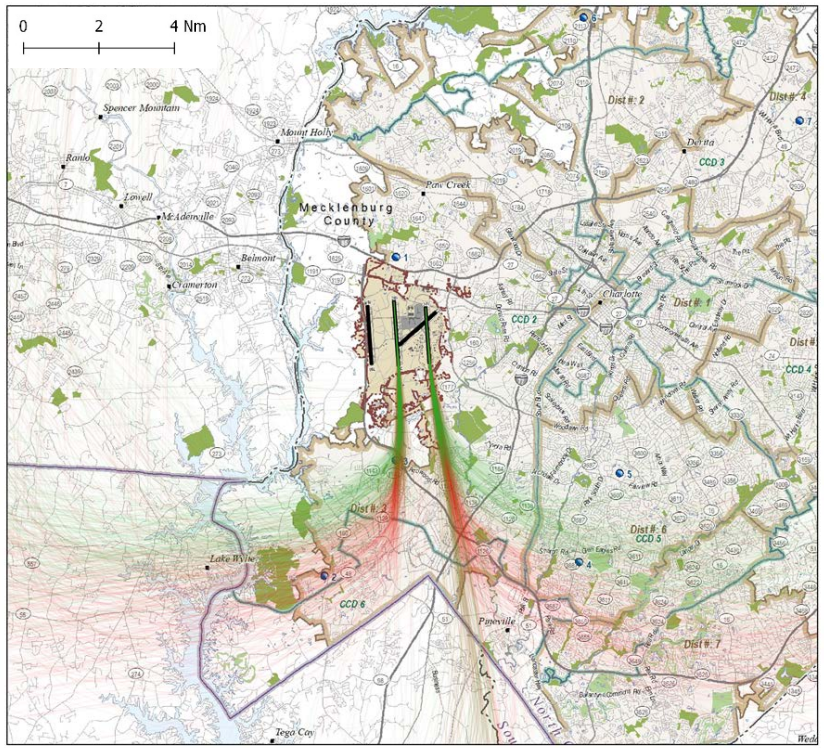
Additional analysis requested by the ACR



South Flow Departures - Modified Flight Tracks with Turns at 3,500 feet MSL Compared to Original (April 6, 2018)



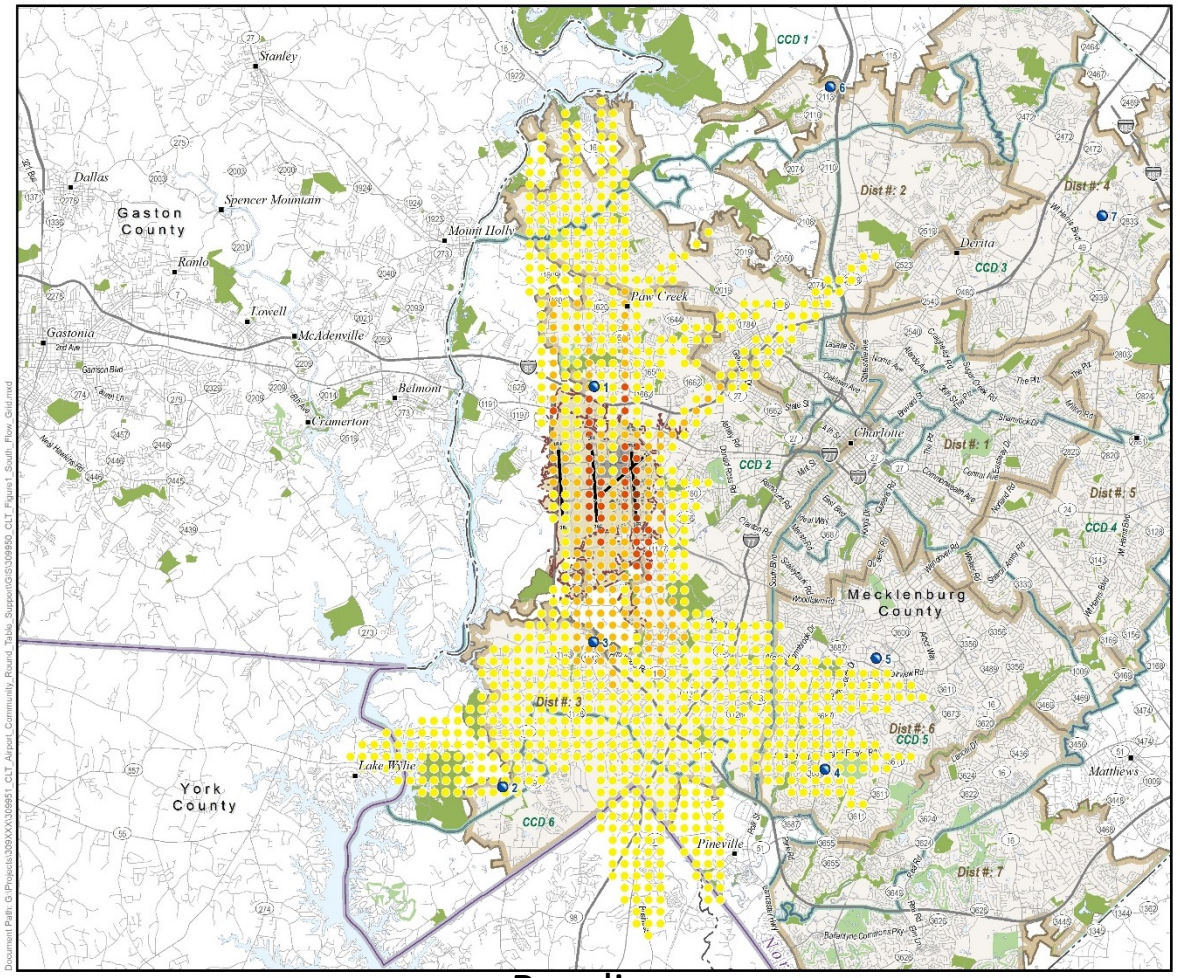




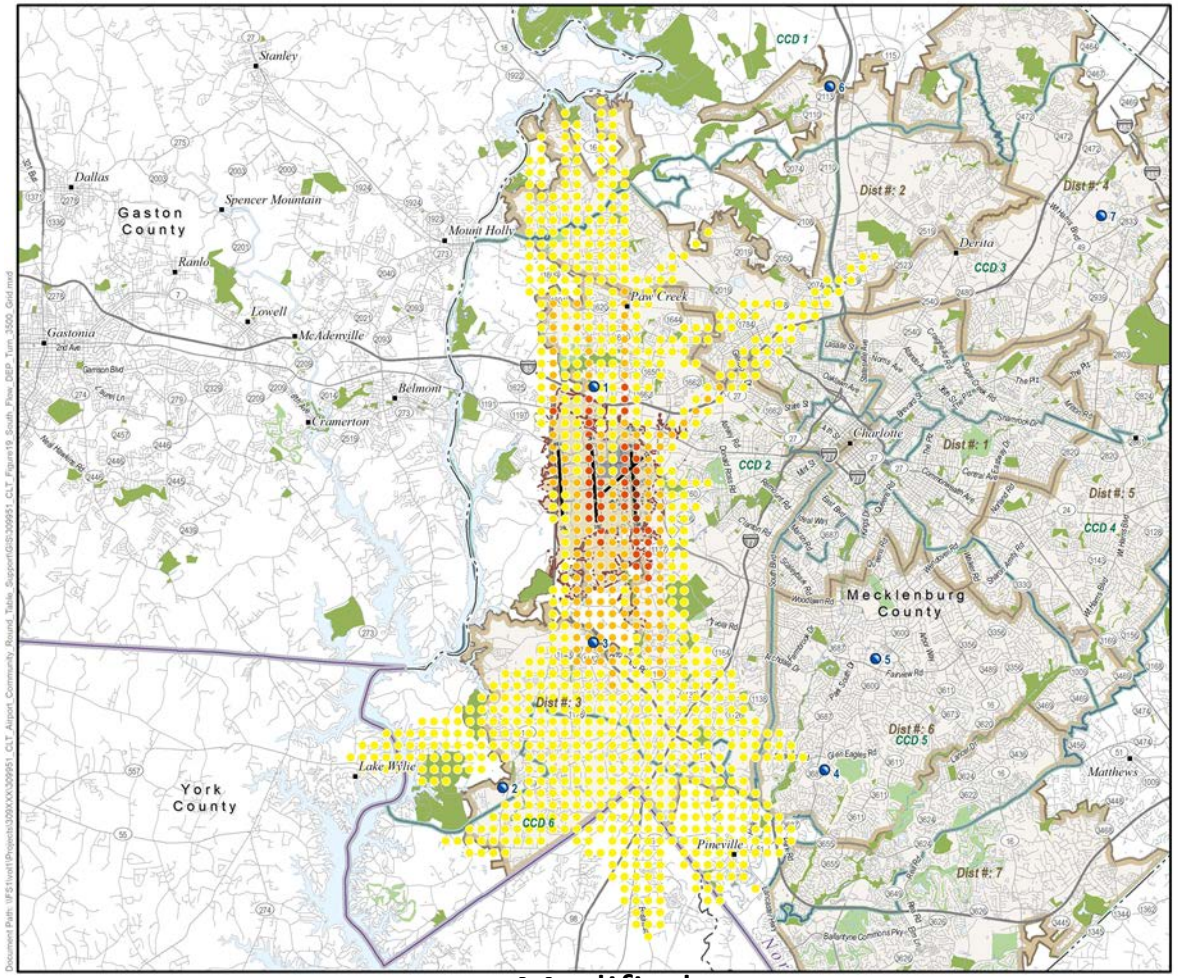
Legend

- Runways
- 2018 South Flow Departures
- Potential Tracks on a 3,500ft Altitude Based Turn
- State Boundary
- Highway
- Major Roads
- Park / Open Space
- County Boundary
- Minor Roads
- Railroad
- Water
- Landmark Locations
  1. West Mecklenburg High
  2. Southwest Middle School
  3. Olympic Community High School
  4. Quail Hollow Middle School
  5. South Park Mall
  6. NorthLake Mall
  7. UNCC
- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

Noise Analysis (Lmax of 70 dB and greater) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 3,500 feet MSL

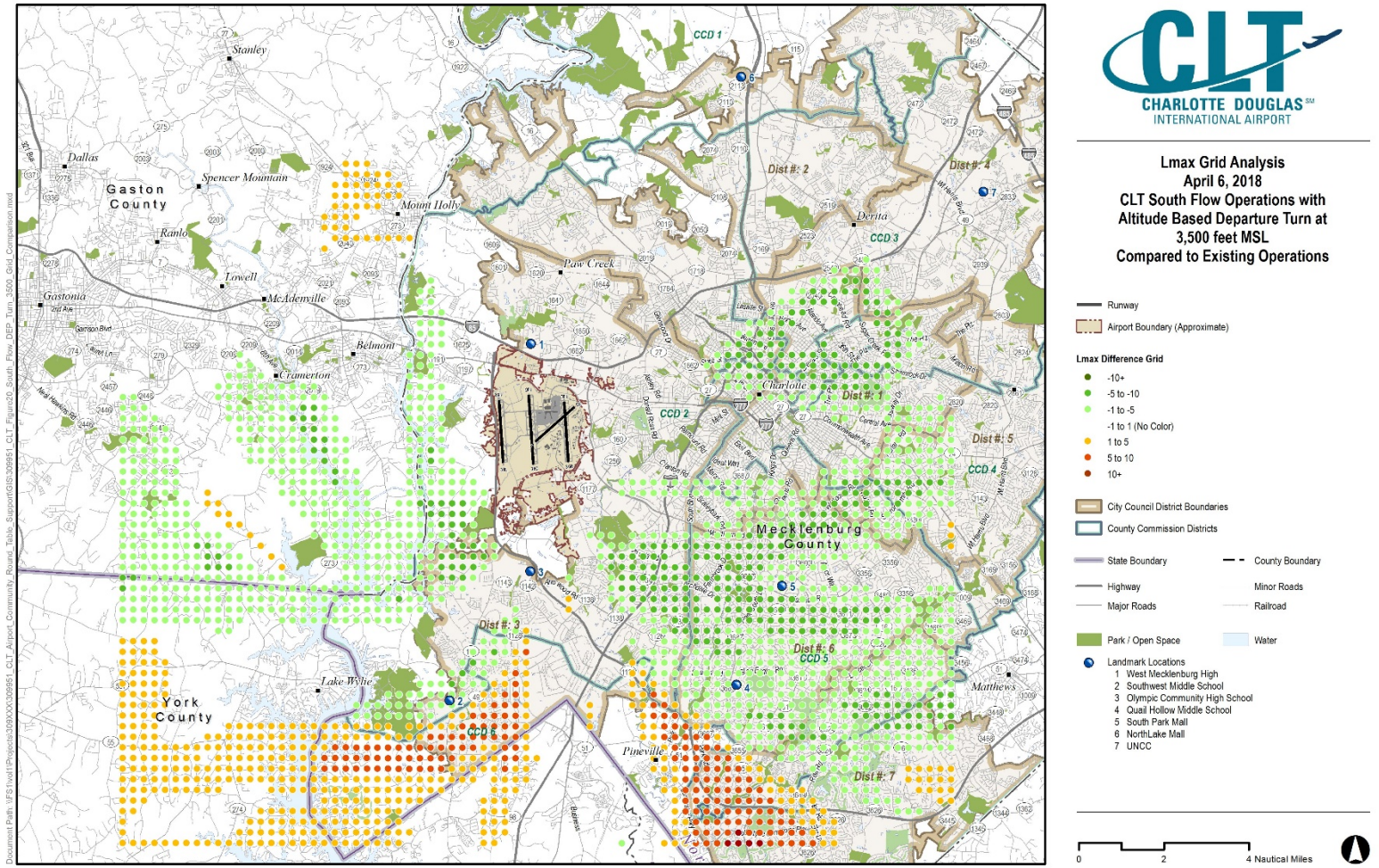


Baseline



Modified

Areas of Change in Noise Levels of 3,500 feet MSL Altitude Based Turns Compared to Unmodified Departures



CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Lmax Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 3,500 feet MSL
Compared to Existing Operations

- Runway
- Airport Boundary (Approximate)

Lmax Difference Grid

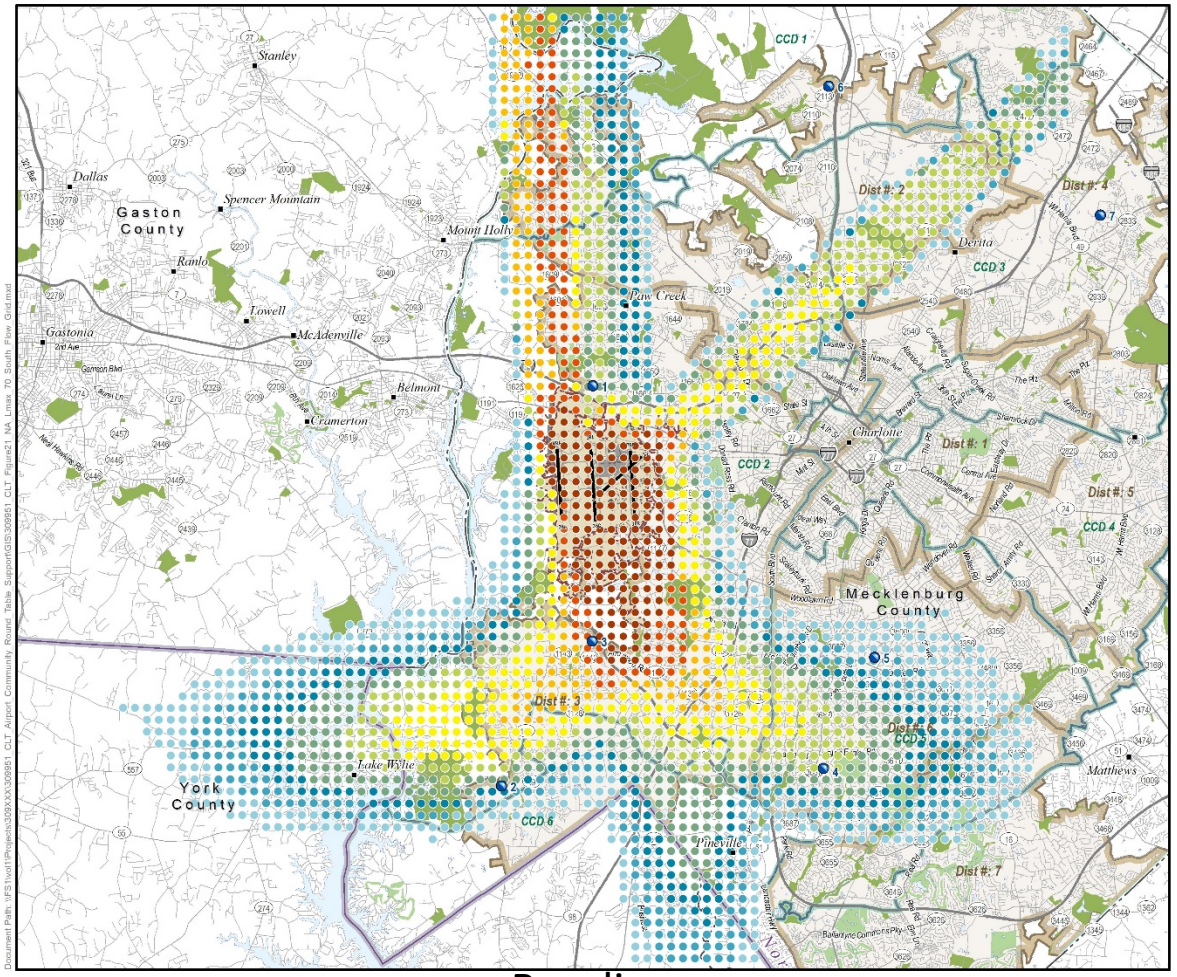
- -10+
- -5 to -10
- -1 to -5
- -1 to 1 (No Color)
- 1 to 5
- 5 to 10
- 10+

- City Council District Boundaries
- County Commission Districts
- State Boundary
- County Boundary
- Highway
- Minor Roads
- Major Roads
- Railroad
- Park / Open Space
- Water

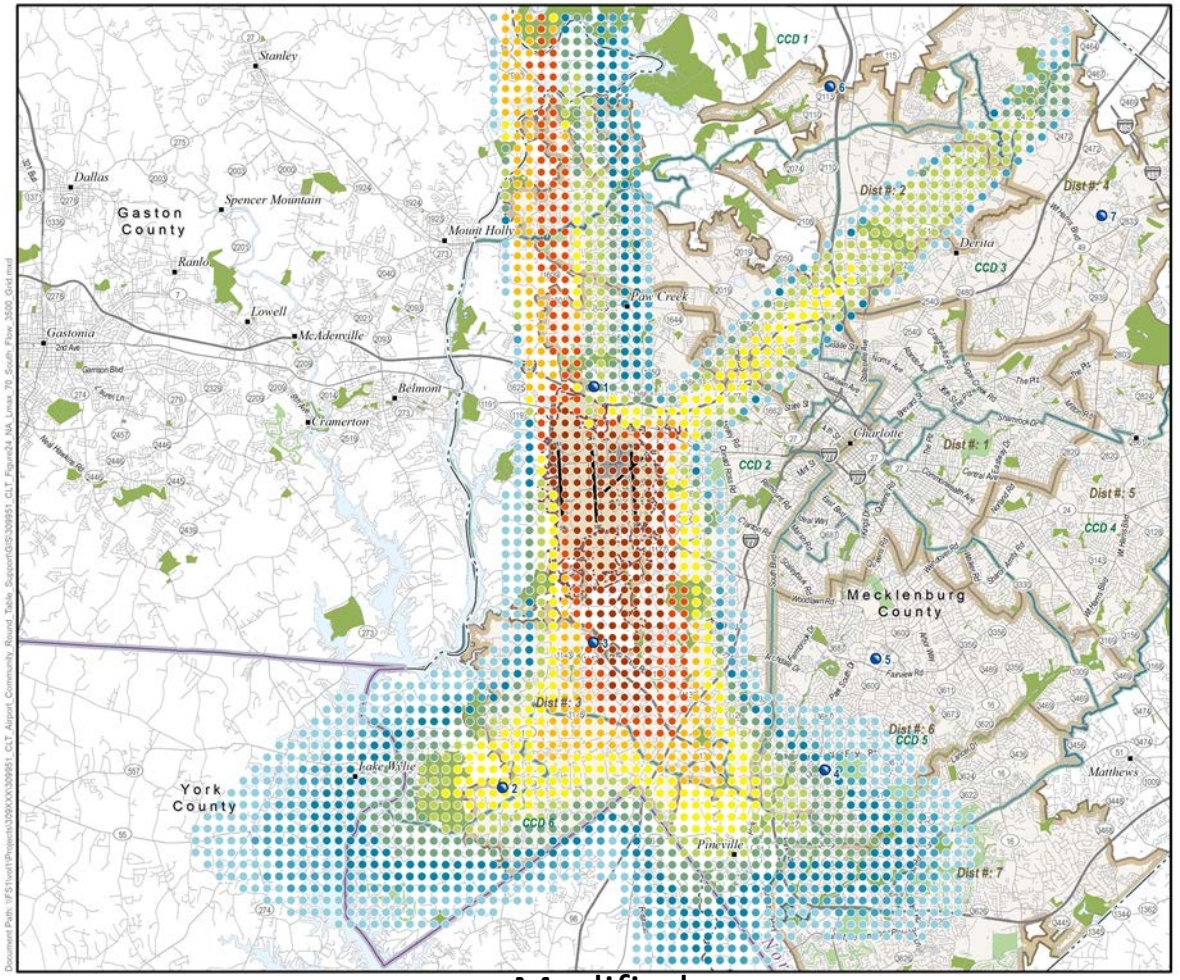
Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

0 2 4 Nautical Miles

Number of Events Analysis (N70) Comparison: Unmodified South Flow Departures to Altitude Based Turns at 3,500 feet MSL

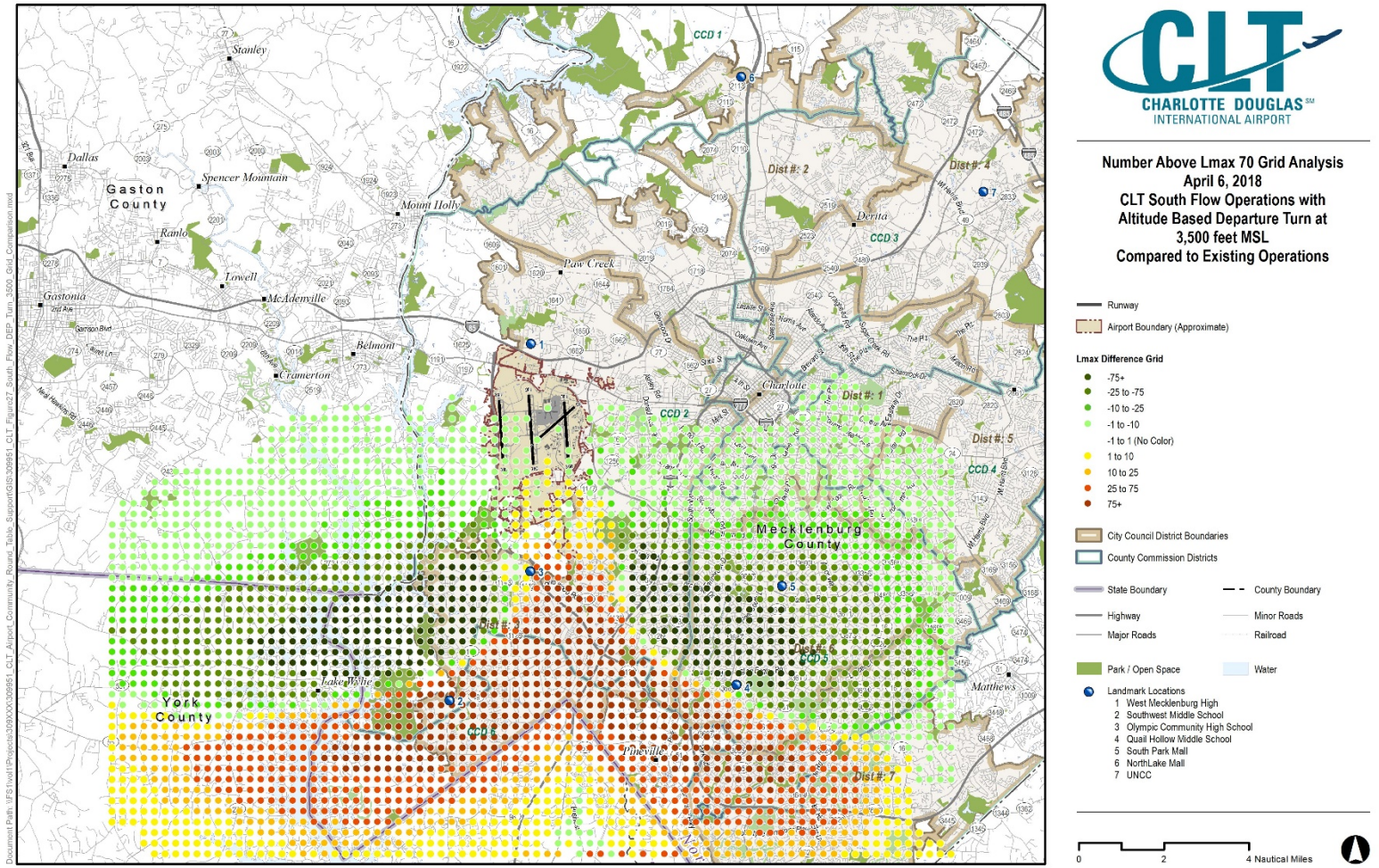


Baseline



Modified

Areas of Change in Number of Events of 3,500 feet MSL Altitude Based Turns Compared to Unmodified Departures



CLT
CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

Number Above Lmax 70 Grid Analysis
April 6, 2018
CLT South Flow Operations with Altitude Based Departure Turn at 3,500 feet MSL
Compared to Existing Operations

Runway
Airport Boundary (Approximate)

Lmax Difference Grid
- -75+
- -25 to -75
- -10 to -25
- -1 to -10
- -1 to 1 (No Color)
- 1 to 10
- 10 to 25
- 25 to 75
- 75+

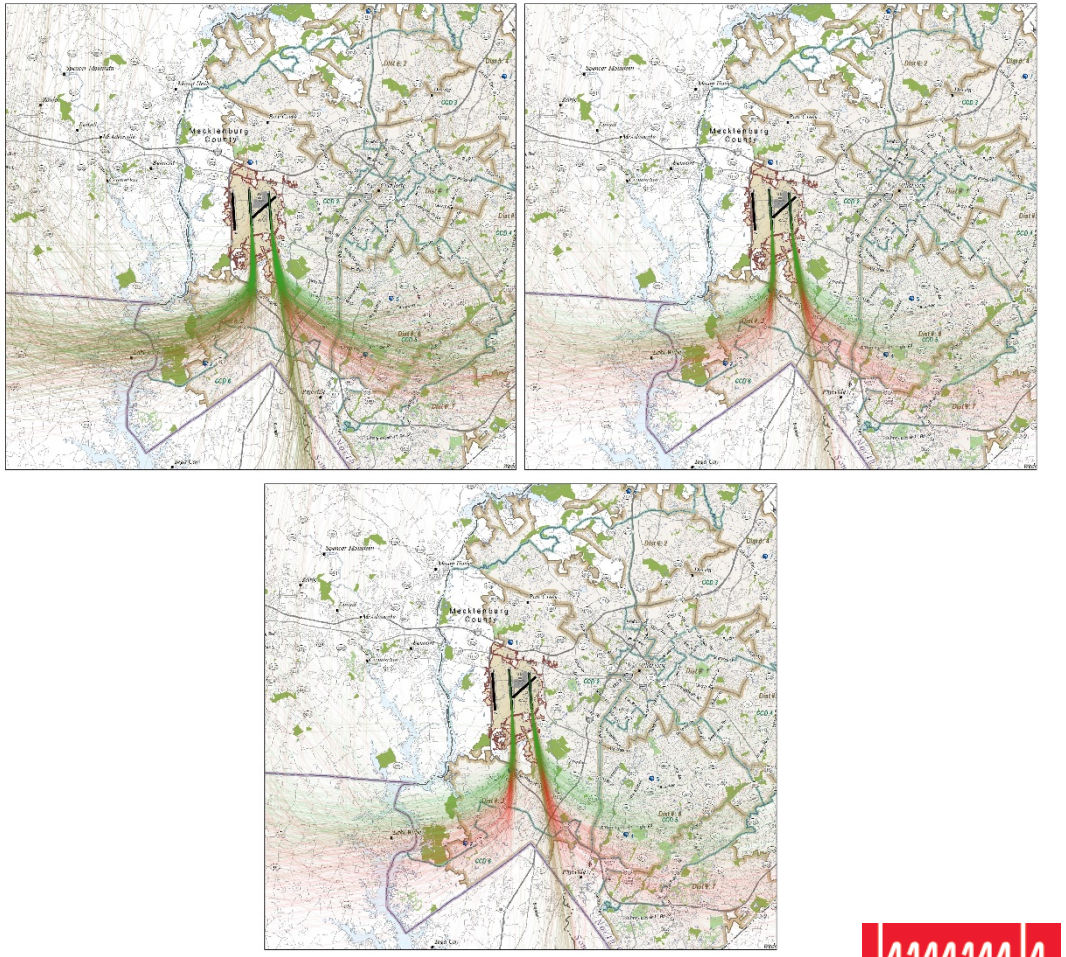
City Council District Boundaries
County Commission Districts
State Boundary
County Boundary
Highway
Minor Roads
Major Roads
Railroad
Park / Open Space
Water

Landmark Locations
1 West Mecklenburg High
2 Southwest Middle School
3 Olympic Community High School
4 Quail Hollow Middle School
5 South Park Mall
6 NorthLake Mall
7 UNCC

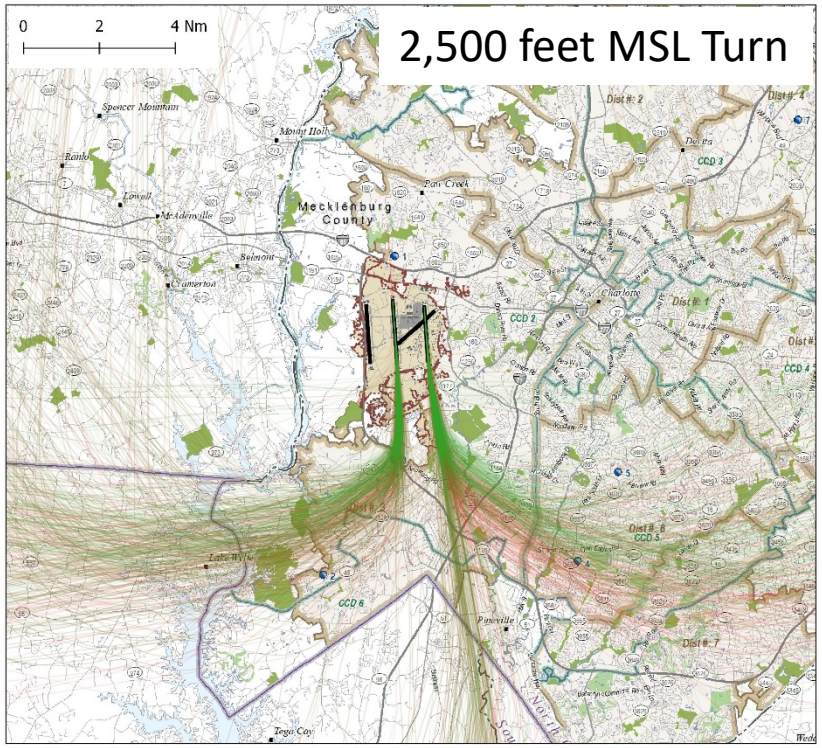
0 2 4 Nautical Miles

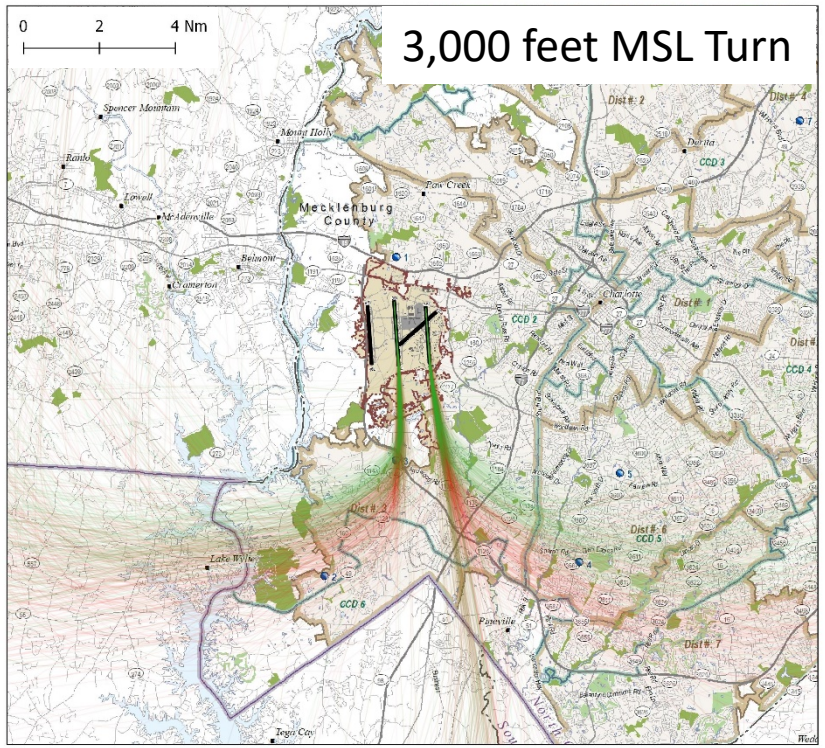
Altitude Based Turns Analysis Conclusions

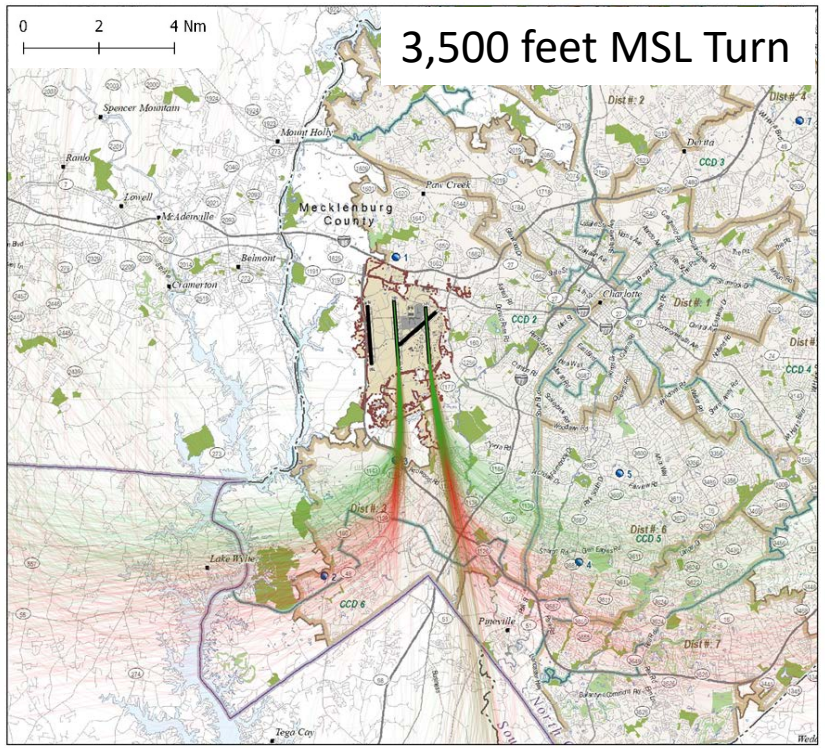
Additional analysis requested by the ACR



South Flow Departures – Change in Locations of Flight Tracks with Altitude Based Turns Compared to Original (April 6, 2018)



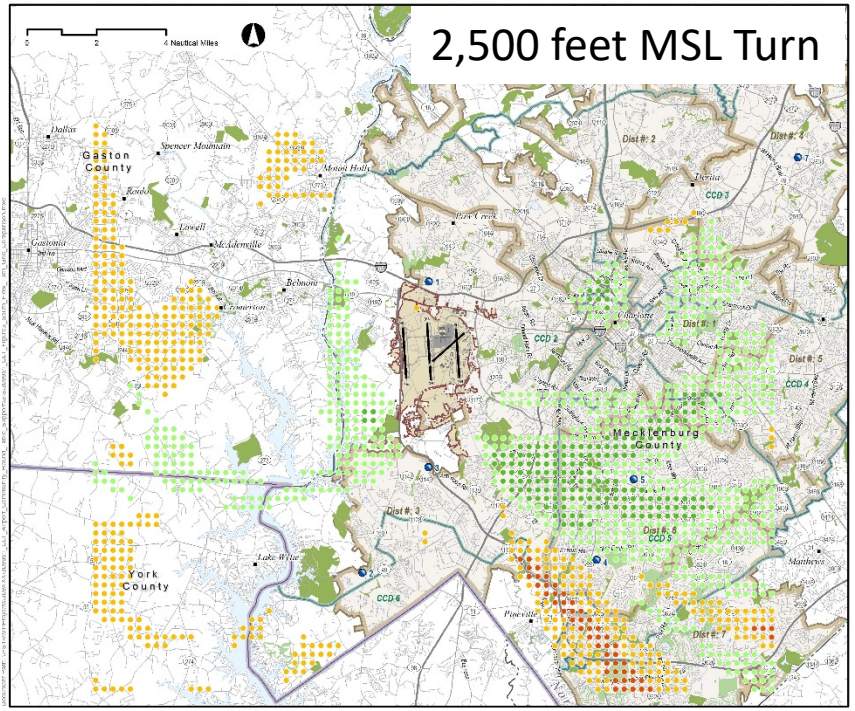


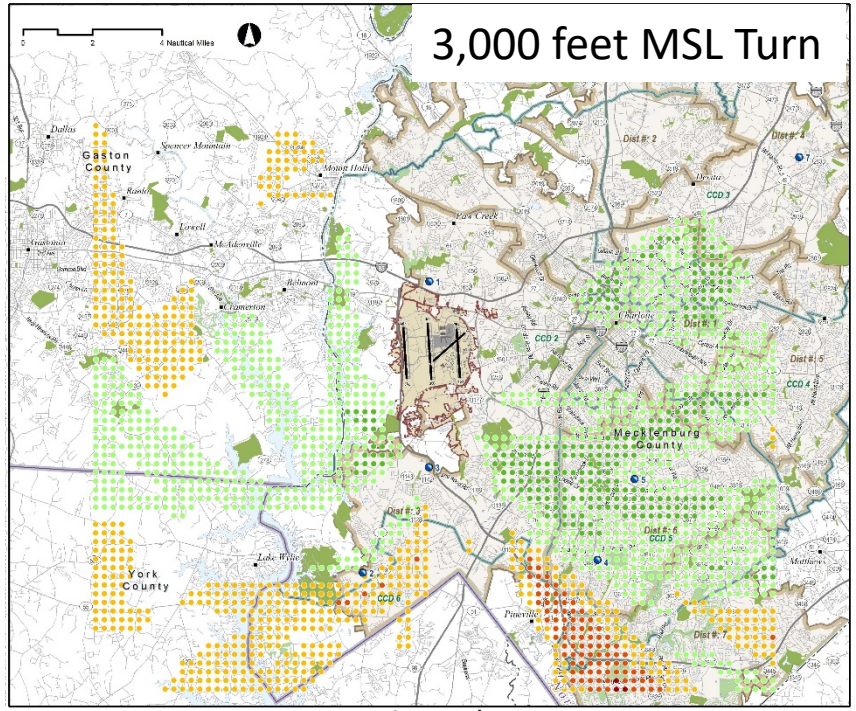


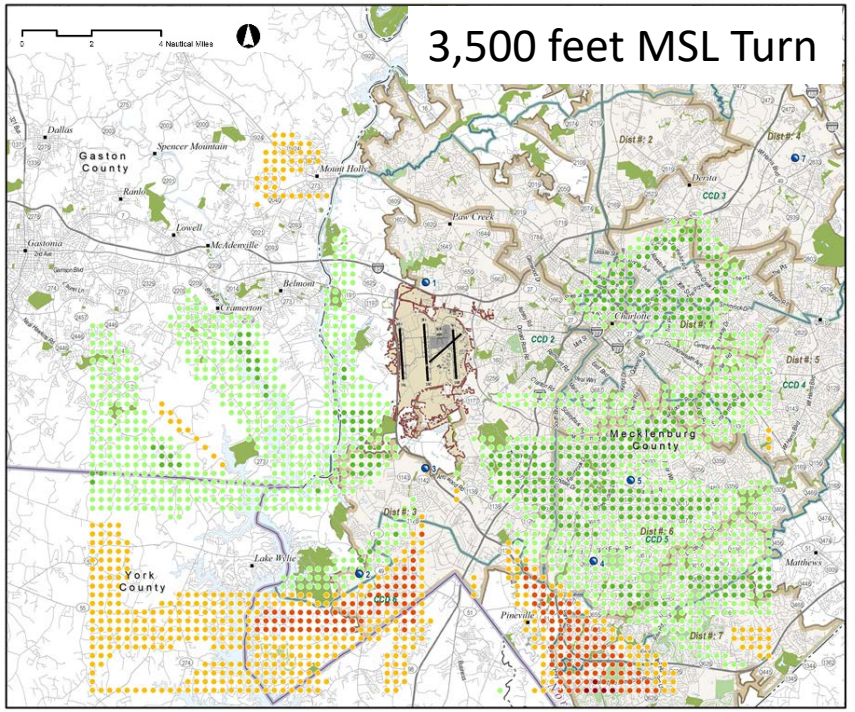
Legend

- Runways
- 2018 South Flow Departures
- Potential Tracks on a Altitude Based Turn
- State Boundary
- Highway
- Major Roads
- Park / Open Space
- County Boundary
- Minor Roads
- Railroad
- Water
- Landmark Locations
  1. West Mecklenburg High
  2. Southwest Middle School
  3. Olympic Community High School
  4. Quail Hollow Middle School
  5. South Park Mall
  6. NorthLake Mall
  7. UNCC
- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

South Flow Departures – Areas of Change in Noise Levels of Flight Tracks with Altitude Based Turns Compared to Original (April 6, 2018)







Legend

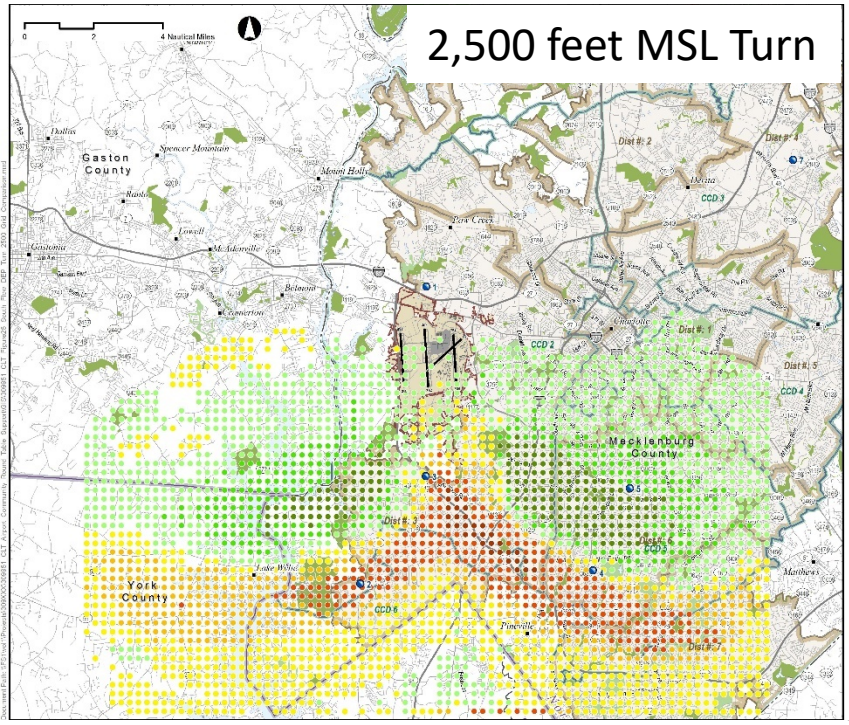
Lmax Difference Grid
- -10+
- -5 to -10
- -1 to -5
- -1 to 1 (No Color)
- 1 to 5
- 5 to 10
- 10+

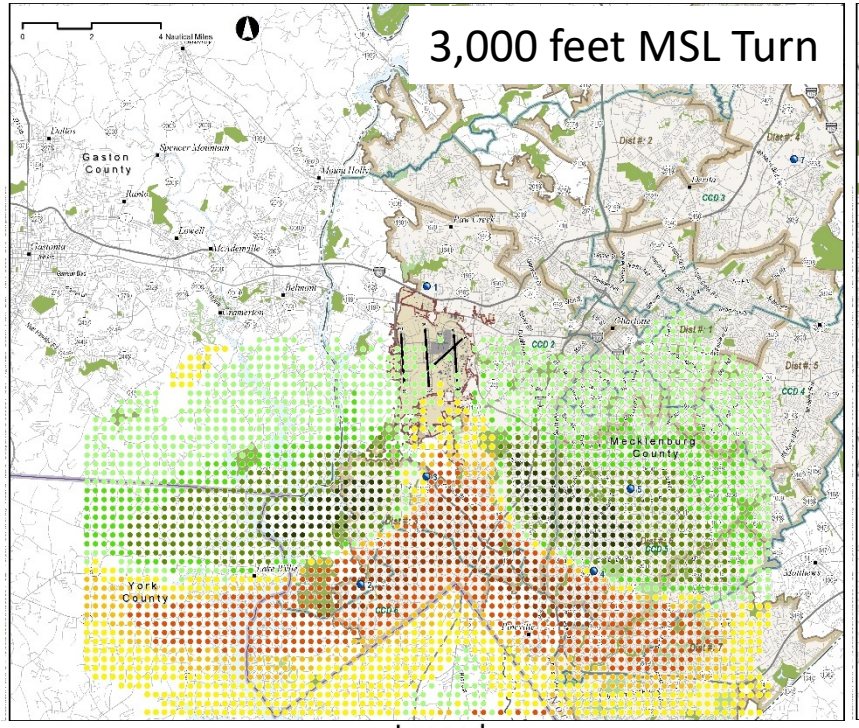
- State Boundary
- Highway
- Major Roads
- Park / Open Space
- County Boundary
- Minor Roads
- Railroad
- Water

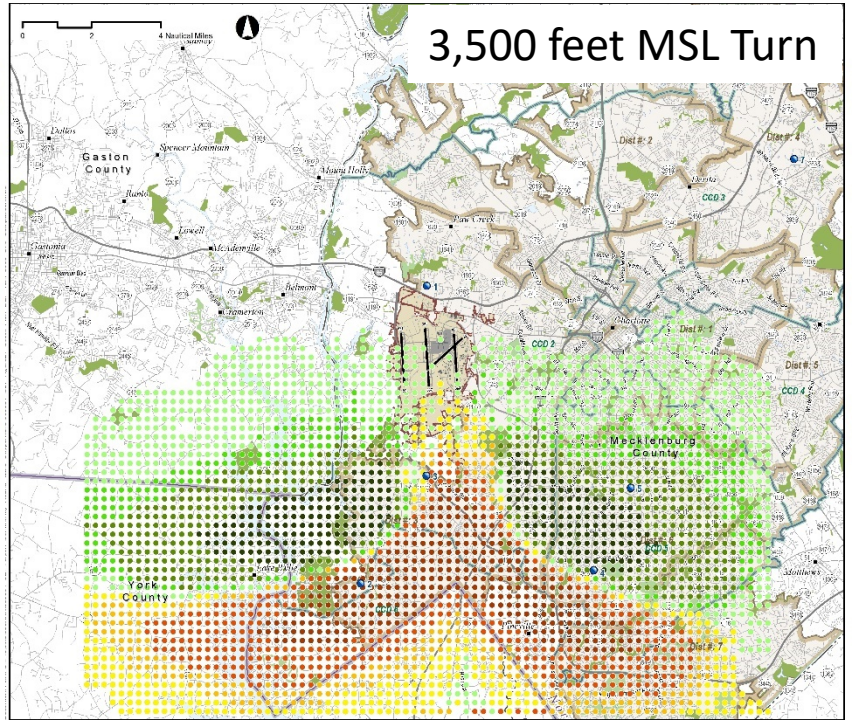
Landmark Locations
1. West Mecklenburg High
2. Southwest Middle School
3. Olympic Community High School
4. Quail Hollow Middle School
5. South Park Mall
6. NorthLake Mall
7. UNCC

- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

South Flow Departures – Areas of Change in Number of Events of Flight Tracks with Altitude Based Turns Compared to Original (April 6, 2018)







Legend

NA 70 Lmax Grid
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 150
- 151 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- > 500

- State Boundary
- County Boundary
- Highway
- Minor Roads
- Major Roads
- Railroad
- Park / Open Space
- Water

Landmark Locations
1. West Mecklenburg High
2. Southwest Middle School
3. Olympic Community High School
4. Quail Hollow Middle School
5. South Park Mall
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7. UNCC

- Airport Boundary (Approximate)
- City Council District Boundaries
- County Commission Districts

Noise Analysis Results of Altitude Based Turns

- Altitude based departure turns for south flow departures would potentially:
  - Shift departure turns further to the south before making turn to the west or east
  - Correspondingly decrease noise levels over areas closest to the airport, and increase noise levels further from the airport to the south by delaying the turns
  - Increase dispersion for turns to the west and southeast as the altitude at which aircraft turn is increased, with the greatest dispersion being achieved with a turn at 3,500 feet MSL
  - Increased dispersion with increased aircraft turn altitudes is expected, as greater turning altitudes introduce more variability on where aircraft will turn based on climb performance

Noise Analysis Results of Altitude Based Turns

- Utilizing an altitude based turn could negatively affect airport capacity due to the uncertainty of aircraft turn locations
  - However, may be a relatively small affect due to the distances being known to occur within a specific area that is not all that large an area
  - The greater the increase in aircraft turn altitudes, the greater the uncertainty where aircraft may turn and negatively affect capacity

Altitude Based Turns – Next Steps

- Quantitatively assess affect of altitude based turns on airport capacity and throughput
- Conduct additional modeling of altitude based turns with a complete year of operations data to quantify potential affects of seasonal variability

Discussion

CLT Technical Consultant to the ACR