Collective Analyses Groupings

Continuation of discussion of from October 2019 meeting

of potential/suggested collective groupings of ACR slate recommendations

ACR Slate Recommendations for Analysis – 2019

1. Noise abatement departure profile (NADP) procedures[1]
2. Continuous descent approaches (CDAs)
3. Alternating downwind arrival rails
4. Altitude based turns for departures
5. Divergent departure headings
6. Delay initial aircraft turns for south departures
7. Change headings of initial aircraft turns for south departures
8. Remove the two-mile restriction for south departures
9. Maintain aircraft altitude of 6,000 feet on downwinds[2]

Notes *1: NADPs are moving forward outside of the full ACR slate submitted to the FAA.*
2: New ACR slate recommendation adopted at the October 2019 meeting.

Revised Potential Collective Analysis Matrix

Combinations of Existing ACR Slate Measures previously evaluated

ACR Proposed Measure	1	2	3	4	5	6	7	8	9	10	11	12
Alternating Downwind Rails	X	X	X	X	X	X						
Altitude-based Turns	X	X		X			X	X		X		
Divergent departure headings			X						X			
Delay initial turns on departure				X						X		
Change initial departure turn heading						X						X
Remove 2-mile restriction		X			X			X			X	
CDAs							X	X	X	X	X	X

Revised Potential Combined Measures for Additional Analysis Matrix

Potential Combinations of ACR Slate Measures that would require additional analysis

ACR Proposed Measure	13	14	15	16	17	18	19	20
Alternating Downwind Rails	X	X	X	X	X	X	X	
Altitude-based Turns	X	X	X	X				
Divergent departure headings			X	X	X	X		
Delay initial turns on departure					X			
Change initial departure turn heading	X	X					X	
Remove 2-mile restriction		X		X		X	X	
Maintain 6,000 foot downwind altitudes	X	X	X	X	X	X	X	X
CDAs	X	X	X	X	X	X	X	X

Summary of ACR Collective Analysis Groupings

- Total of 20 possible collective groupings of ACR slate measures for analysis
  - 12 Groupings (1-12) could incorporate our existing individual slate measure analysis inputs with minor modifications
  - Eight groupings (13-20) would require reworking of individual slate measure analysis inputs
- All groupings will require a long runtime to complete noise modeling in the Aviation Environmental Design Tool (AEDT) due to the ACR-recommended increased size and detail of the expanded grid
- This is especially the case for groupings including alternating downwinds, as each single grouping requires three separate runs (4, 5, and 6 mile downwind model runs) combined with other alternatives

ACR Collective Analysis Groupings Suggested for Analysis

- Out of the 20 presented possible groupings of measures for collective analysis we recommend the following for three for ACR consideration:
  - *Collective Grouping #10: Continuous descent arrivals, altitude based turns and delaying initial turns on departure*
  - *Collective Grouping #12: Continuous descent arrivals and change initial departure heading*
  - *Collective Grouping #18: Continuous descent arrivals, divergent departure headings, removal of the existing 2-mile restriction and 6,000 foot downwind altitudes*
- Alternating downwind flight paths provide significant barriers to implementation as well as requiring three extensive model runs for each collective analysis, so we are recommending they not be included with the collective analysis for this grouping

ACR Collective Analysis Groupings Suggested for Analysis

- Collective Grouping #10: Continuous descent arrivals, altitude based turns and delaying initial turns on departure
  - Pros:
    - Reduced noise exposure from continuous descents at reduced power settings
    - Increased aircraft approach altitudes
    - Ability to maintain/improve dispersion of departures due to variability of aircraft turn altitudes
    - Ability to shift aircraft departure turns further from the airport
  - Cons:
    - Concentration of aircraft flight paths on base legs and low utilization
    - Increased controller workload
    - Potential to shift departure noise over communities further from the airport

ACR Collective Analysis Groupings Suggested for Analysis

- Collective Grouping #12: Continuous descent arrivals and change initial departure heading
  - Pros:
    - Reduced noise exposure from continuous descents at reduced power settings
    - Increased aircraft approach altitudes
    - Ability to maintain aircraft departure turns in current location and shift aircraft departure flight paths further from the airport
  - Cons:
    - Concentration of aircraft flight paths on base legs and low utilization
    - Potential to shift departure noise over communities further from the airport
    - Potential reduction in dispersion due to reduced turn angle
    - Potential reduction in departure airport throughput due to increased time for aircraft to obtain divergence

ACR Collective Analysis Groupings Suggested for Analysis

- Collective Grouping #18: Continuous descent arrivals, divergent departure headings, removal of the existing 2-mile restriction and 6,000 foot downwind altitudes
  - Pros:
    - Potential to better disperse departures based on destination
    - Potential to turn aircraft closer to the airport
    - Increased airport departure throughput
    - Ability to keep aircraft on downwind legs at higher altitudes
    - Reduced noise exposure from continuous descents at reduced power settings
    - Increased aircraft approach altitudes
  - Cons:
    - Potential new communities exposed to departure noise
    - Lengthened downwinds
    - Concentration of aircraft flight paths on base legs and low utilization

ACR Collective Analysis Groupings Suggested for Analysis

- We believe these three recommendations provide a balance between ease of modeling and exploring new combined alternatives
- Additional collective groupings may be considered or analyzed. However, doing so would require extensive rework of modeling inputs and expanded schedules for completion
- *Notes:*
  - *The remainder of this presentation include each of the 20 possible groupings along with the pros, cons and implementation concerns for your review after the meeting as there is too much to cover for tonight's meeting*
  - *These groupings have also been provided in a handout separate from this presentation to facilitate easier review*

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
1. Alternating Downwind Rails and Altitude Based Turns	• Relief under location of existing downwinds for two year periods • Potential to delay and better disperse departure turns based on turn altitude	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Increased controller workload • Decreased airport throughput	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds
2. Alternating Downwind Rails, Altitude Based Turns, Divergent Departure Headings, and Removal of 2-mile Restriction	• Relief under location of existing downwinds for two year period • Ability to shift aircraft departure turns closer to the airport depending on selected altitude • Potential increase in airport departure throughput due to earlier divergence	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Increased controller workload • Potential to shift departure noise over communities close to the airport	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
3. Alternating Downwind Rails and Divergent Departure Headings	• Relief under location of existing downwinds for two year periods • Ability to better distribute aircraft departure turns based on destination • Potential reduced workload for air traffic controllers depending on procedure design	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential decreased airport departure throughput for some headings due to longer time required for aircraft headings to diverge • Potential exposure of new communities to aircraft noise	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds
4. Alternating Downwind Rails, Altitude Based Turns, and Delaying Initial Turns on Departure	• Relief under location of existing downwinds for two year period • Ability to maintain/improve dispersion of departures due to variability of aircraft turn altitudes • Ability to shift aircraft departure turns further from the airport	• Requires extensive controller training, procedure design, and environmental review • Increased controller workload • Potential to shift departure noise over communities further from the airport	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
5. Alternating Downwind Rails and Remove 2-Mile Departure Restriction	• Relief under location of existing downwinds for two year periods • Ability to shift aircraft departure turns closer to the airport • Increase in airport departure throughput due to earlier divergence	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential to shift departure noise over communities close to the airport	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds
6. Alternating Downwind Rails and Change Initial Departure Heading	• Relief under location of existing downwinds for two year period • Ability to maintain aircraft departure turns in current location and shift aircraft departure flight paths further from the airport	• Requires extensive controller training, procedure design, and environmental review • Potential to shift departure noise over communities further from the airport • Potential reduction in dispersion due to reduced turn angle • Potential reduction in departure airport throughput due to increased time for aircraft to obtain divergence	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
7. CDAs and Altitude Based Turns	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Potential to delay and better disperse departure turns based on turn altitude	• Concentration of aircraft flight paths on base legs and low utilization • Increased controller workload • Decreased airport throughput	
8. CDAs, Altitude Based Turns, Divergent Departure Headings, and Removal of 2-mile Restriction	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Ability to shift aircraft departure turns closer to the airport depending on selected altitude • Potential increase in airport departure throughput due to earlier divergence	• Concentration of aircraft flight paths on base legs and low utilization • Increased controller workload • Potential to shift departure noise over communities close to the airport	

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
9. CDAs and Divergent Departure Headings	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Ability to better distribute aircraft departure turns based on destination • Potential reduced workload for air traffic controllers depending on procedure design	• Concentration of aircraft flight paths on base legs and low utilization • Potential decreased airport departure throughput for some headings due to longer time required for aircraft headings to diverge • Potential exposure of new communities to aircraft noise	
10. CDAs, Altitude Based Turns, and Delaying Initial Turns on Departure	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Ability to maintain/improve dispersion of departures due to variability of aircraft turn altitudes • Ability to shift aircraft departure turns further from the airport	• Concentration of aircraft flight paths on base legs and low utilization • Increased controller workload • Potential to shift departure noise over communities further from the airport	

Measures Requiring Minor Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
11. CDAs and Remove 2-Mile Departure Restriction	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Ability to shift aircraft departure turns closer to the airport • Increase in airport departure throughput due to earlier divergence	• Concentration of aircraft flight paths on base legs and low utilization • Potential to rotate arrival noise over different communities • Potential to shift departure noise over communities close to the airport	
12. CDAs and Change Initial Departure Heading	• Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes • Ability to maintain aircraft departure turns in current location and shift aircraft departure flight paths further from the airport	• Concentration of aircraft flight paths on base legs and low utilization • Potential to shift departure noise over communities further from the airport • Potential reduction in dispersion due to reduced turn angle • Potential reduction in departure airport throughput due to increased time for aircraft to obtain divergence	

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
13. Alternating Downwind Rails, Altitude Based Turns, Change Initial Departure Heading, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to delay and better disperse departure turns based on turn altitude • Potential to change areas overflown by departures • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Increased controller workload • Decreased airport throughput • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
14. Alternating Downwind Rails, Altitude Based Turns, Change Initial Departure Heading, Remove 2-Mile Restriction, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to better disperse departure turns based on turn altitude • Potential to turn departures closer to the airport • Potential to better disperse departures based on destination • Potential reduced workload for air traffic controllers depending on procedure design • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise closer to the airport • Potential decreased airport departure throughput depending on headings due to divergence • Increased controller workload • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
15. Alternating Downwind Rails, Altitude Based Turns, Divergent Departure Headings, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to delay and better disperse departure turns based on turn altitude • Potential to better disperse departures based on destination • Potential to change areas overflown by departures • Potential reduced workload for air traffic controllers depending on procedure design • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Potential decreased airport departure throughput for some headings due to longer time required for aircraft headings to diverge • Increased controller workload • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
16. Alternating Downwind Rails, Altitude Based Turns, Divergent Departure Headings, Remove 2-Mile Restriction, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to delay and better disperse departure turns based altitude • Potential to turn departures closer to the airport • Potential to better disperse departures based on destination • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Potential decreased airport departure throughput for some headings due to longer time required for aircraft headings to diverge • Increased controller workload • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
17. Alternating Downwind Rails, Divergent Departure Headings, Delay Initial Departure Turns, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to better disperse departures based on destination • Potential to change areas overflown by departures • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Potential decreased airport departure throughput for some headings due to longer time required for aircraft headings to diverge • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
18. Alternating Downwind Rails, Divergent Departure Headings, Remove 2-Mile Restriction, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to better disperse departures based on destination • Potential to turn aircraft closer to the airport • Increased airport departure throughput • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds

Measures Requiring Substantial Additional Analysis

ACR Collective Grouping	Pros	Cons	Implementation Concerns
19. Alternating Downwind Rails, Change Initial Departure Heading, Remove 2-Mile Restriction, 6,000 foot Downwind Altitudes, and CDAs	• Relief under location of existing downwinds for two year periods • Potential to change areas overflown by departures • Potential to turn aircraft closer to the airport • Increased airport departure throughput • Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Requires extensive controller training, procedure design, and environmental review • Potential to rotate arrival noise over different communities • Potential new communities exposed to departure noise • Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	• Lengthy environmental review and a accommodation of FAA publication cycles for downwinds
20. 6,000 foot Downwind Altitudes and CDAs	• Ability to keep aircraft on downwind legs at higher altitudes • Reduced noise exposure from continuous descents at reduced power settings • Increased aircraft approach altitudes	• Lengthened downwinds • Concentration of aircraft flight paths on base legs and low utilization	

Discussion