

**PHASE III DRAINAGE REPORT
FOR**

LINCOLN STATION

**HERITAGE HILLS – SECTION 10, FILING 2, 2ND AMENDMENT
LOTS 7-A1, 8-A1 & 8-A2**

LONE TREE, COLORADO

Prepared For:

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February 12, 2021

ENGINEER'S CERTIFICATION STATEMENT

"This report and plan for the Phase III drainage design of Lincoln Station was prepared by me (or under my direct supervision) in accordance with the provisions of the *City of Lone Tree Storm Drainage Design and Technical Criteria* for the owners thereof. I understand that the City of Lone Tree does not and will not assume liability for drainage and erosion control facilities done by others."

SIGNATURE: _____

Kristofer K. Wiest, PE

Registered Professional Engineer State of Colorado #46080

For and on Behalf of Merrick & Company

DEVELOPER'S CERTIFICATION STATEMENT

"Century Communities. hereby certifies that the drainage facilities for Lincoln Station shall be constructed according to the design presented in this report. I understand that the City of Lone Tree does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that the City of Lone Tree reviews drainage plans pursuant to Lone Tree Municipal Code, Chapter 15, Article 1; but cannot, on behalf of Lincoln Station, guarantee that final drainage design review will absolve Century Communities and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Site Improvement Plan and/or Final Plan does not imply approval of my engineer's drainage design."

Name of Developer

Authorized Signature

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APPENDIX

Appendix A - Supporting Documentation

Appendix B - Hydrologic Calculations

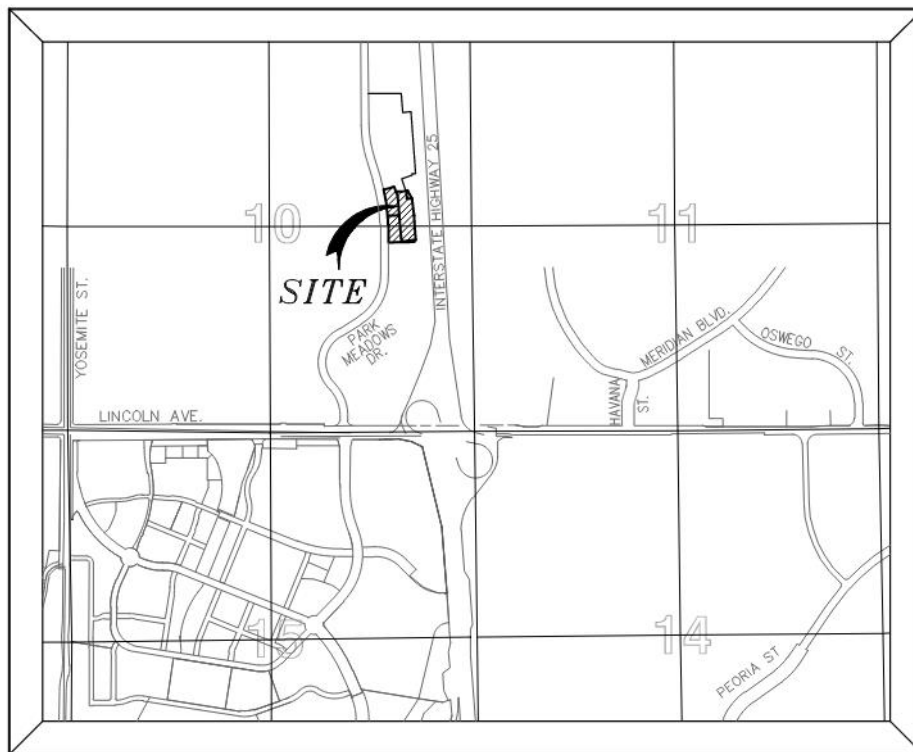
Appendix C – Hydraulic Calculations (Excluded: To be Included in PH III Drainage Report)

Appendix D - Site Maps

I. GENERAL LOCATION AND DESCRIPTION

A. SITE LOCATION

This Phase III Drainage Report is being prepared for the proposed residential – multifamily development located northeast of the intersection of Park Meadows Drive and Station Street, within the Lincoln Station Development (Hereinafter referred to as the “Site”). The project Site consists of Heritage Hills Filing No. 2, 2nd Amendment, Lots 8-A1 and 8-A2, as well as the Kaiser/Lincoln Station Parking Garage Condominiums, Lot 7-A1, located in the East half of Section 10, Township 6 South, Range 67 West of the Sixth Principal Meridian, County of Douglas, State of Colorado. The Site is bounded by Park Meadows Drive to the west, Station Street along the south and east, as well as a service drive and parking lot to the north. The Site is zoned PD.



VICINITY MAP

SCALE: 1" = 2000'

FIGURE 1

B. DESCRIPTION OF PROPERTY

The proposed Site is 5.2 acres, more or less. It is anticipated the Site will consist of a single residential multi-family building partially wrapping the existing on-site parking garage as well as an addition atop the existing parking garage. The proposed building is anticipated to include approximately 426 multi-family dwelling units, a club house and amenity center and a dog park located above the existing parking garage. The Site will also include a paved service drive, surface parking, curb and gutter, hardscaping, and landscaping.

Currently the Site consists of undeveloped land with vegetation consisting of native grasses, weeds, and soils. The proposed improvements will disturb the entire Site with excavation, grading, utility installation, and other construction activities. An existing two story parking garage exists on the eastern portion of the Site and will remain with proposed improvements.

There is only one soil type on the Site as identified in the Natural Resources Conservation Service (NRCS) Soils Classification Map: Fondis clay loam, classified as Hydrologic Soil Group C. A copy of the soils classification map is included in Appendix A. Soils classified as Group C have moderately high runoff potential and have lower rates of infiltration than Groups A and B which will result in slightly higher runoff rates.

The existing Site contains slopes generally from west to east. There is a roadway highpoint along Park Meadows Drive near the proposed Site service drive. On-site slopes range from 1% to 17% with an approximate 10 feet of fall across the site from west to north.

The Site is located within a Douglas County Unincorporated Area (080049) according to FEMA's Flood Insurance Rate Map 08035C0061H, dated February 17, 2017. No known major or minor existing irrigation canals or significant geologic features exist on the Site. In addition, no major drainageway or existing ditches exist on the Site. There is an on-site drainage channel located just west of the existing parking garage used to convey on-site flows to on-site storm inlet and storm sewer, flows which are then conveyed to a water quality sand filter basin located at the north east corner of the existing parking garage. The existing parking garage is designed to collect surface runoff by internal area drains and then conveyed to the aforementioned water quality sand filter basin.

There is no known contamination on the Site. The contractor will be responsible for monitoring for contamination throughout the construction activities and any required remediation immediately following the discovery.

II. DRAINAGE BASINS AND SUB-BASINS

A. MAJOR DRAINAGE BASINS

There are no known master plan improvements designated for the Site as well as no known master drainage studies pertaining to the Site. The *Lincoln Station – Phase III Drainage Report* completed by Calibre Engineering dated January 2007 in addition, the *Lincoln Station Phase II and Phase III Drainage Conformance Letter*, also completed by Calibre Engineering and dated March 14, 2008 are the only known drainage studies pertaining to the Site. These documents have been included for reference in Appendix A.

The Site runoff is generally conveyed via existing storm sewer infrastructure to a culvert running west to east under Interstate-25 (I-25) to an outfall in Cottonwood Creek. Prior to runoff being conveyed to the I-25 culvert, runoff will receive Water Quality treatment through an existing in-line and above ground sand filter basin designed for the Site's Water Quality Capture Volume (WQCV). In addition, following the sand filter basin, an existing downstream in-line underground detention vault has been designed for the Site's 100-year storm event detention volume where it will then be released and conveyed to the I-25 culvert.

Cottonwood Creek is tributary to its confluence, Cherry Creek Lake. Historically off-site flows from the south and west were released onto the site, channelized in an existing drainage swale through the Site and conveyed to on-site storm sewer infrastructure which drain to the previously mentioned I-25 culvert. Station Street/RTD bus loop included storm sewer improvements that collect off-site flows and routes them around the Site's property to a detention basin located at the center of the loop north east of the Site. These off-site flows are then routed to the I-25 culvert where they merge with the Site runoff. No existing study or plans have been found for the Station Street/RTD bus loop detention basin to date. The Cherry Creek Overall Basin Map has been included in Appendix A for reference.

B. MINOR DRAINAGE BASINS

The Site is comprised of 13 on-site drainage basins and 4 off-site drainage basins. The proposed basins and design points are depicted on the associated drainage plan included in Appendix D.

TABLE 1 - PROPOSED SUB-BASIN PEAK FLOWS					
Sub-Basin Name	Design Point	Area (ac)	Imp (%)	5-Yr Peak Flow (cfs)	100-Yr Peak Flow (cfs)
A1	2	1.22	90.0%	4.6	9.2
A2	5	1.09	90.0%	4.1	8.2
B1	1	0.23	38.2%	0.4	1.2
B2	2	0.11	47.2%	0.2	0.7
B3	3	0.20	95.9%	0.8	1.6
B4	5	0.12	90.0%	0.5	0.9
C1	10	1.82	90.0%	6.2	12.4
D1	1A	0.10	38.7%	0.2	0.6
D2	2A	0.04	76.4%	0.1	0.3
D3	3A	0.07	36.7%	0.1	0.4
D4	4A	0.17	15.5%	0.1	0.8
D5	4A	0.01	90.0%	0.05	0.1
D6	7	0.09	18.5%	0.1	0.4
On-Site Subtotal		5.30	81.6%	17.4	36.8
O1	1A	0.03	2.0%	0.01	0.1
O2	3A	0.04	17.0%	0.04	0.2
O3	4A	0.12	9.6%	0.1	0.6
O4	9	0.01	90.0%	0.1	0.1
Off-Site Subtotal		0.21	15.4%	0.2	1.0
*TOTAL	0	5.50	79.1%	17.5	37.8
*TOTAL PEAK FLOWS ARE A SUMMATION OF BASIN FLOWS AND DO NOT ACCOUNT FOR HYDRAULIC ROUTING					

The following basins are conveyed and collected on-site by the proposed drainage infrastructure. Runoff from these basins will be conveyed to the existing sand filter basin located at the north east corner of the existing parking garage where it will be treated for water quality. It will then be conveyed to an existing underground detention vault located north of the site in Station Street.

BASIN A1 (Q5=2.1 cfs, Q100=4.3 cfs)

Basin A1 is approximately 0.57 acres and consists entirely of the proposed residential multi-family building. Developed runoff from the basin will sheet flow across the rooftop and collected by localized roof drains. The roof drains will tie-in to the proposed on-site storm sewer infrastructure at design point 1.

BASIN A2 (Q5=2.4 cfs, Q100=4.9 cfs)

Basin A2 is approximately 0.65 acres and consists entirely of the proposed residential multi-family building. Developed runoff from the basin will sheet flow across the rooftop and collected by localized roof drains. The roof drains will tie-in to the proposed on-site storm sewer infrastructure at design point 2.

BASIN A3 (Q5=4.1 cfs, Q100=8.2 cfs)

Basin A3 is approximately 1.09 acres and consists entirely of the proposed residential multi-family building. Developed runoff from the basin will sheet flow across the rooftop and collected by localized roof drains. The roof drains will tie-in to the proposed on-site storm sewer infrastructure at design point 3.

BASIN B1 (Q5=0.4 cfs, Q100=1.2 cfs)

Basin B1 is approximately 0.20 acres consisting of an internal courtyard wrapped by the proposed residential multi-family building and existing garage. The courtyard will contain hardscaping and landscaping improvements. Developed runoff will be conveyed to proposed landscape drains and storm sewer infrastructure and conveyed to design point 1.

BASIN B2 (Q5=0.2 cfs, Q100=0.7 cfs)

Basin B2 is approximately 0.11 acres consisting of an internal courtyard wrapped by the proposed residential multi-family building and existing garage. The courtyard will contain hardscaping and landscaping improvements. Developed runoff will be conveyed to proposed landscape drains and storm sewer infrastructure at design point 2.

BASIN B3 (Q5=0.5 cfs, Q100=0.9 cfs)

Basin B3 is approximately 0.12 acres consisting of an internal courtyard wrapped by the proposed residential multi-family building and existing garage. The courtyard will contain hardscaping improvements as well as a pool. Developed runoff will be conveyed to proposed trench drains and then to the storm manhole at design point 3.

BASIN B4 (Q5=0.8 cfs, Q100=1.5 cfs)

Basin B4 is approximately 0.20 acres consisting of the Site entrance, service drive and parking. The basin is comprised of hardscaping in the form of pavement and sidewalks and landscaping. Developed runoff will sheet flow across the improvements and collected within a centrally located storm sewer inlet at design point 4.

BASIN C1 (Q5=5.9 cfs, Q100=11.8 cfs)

Basin C1 is approximately 1.57 acres consisting of the proposed residential multi-family building garage atop the existing garage. Developed runoff from the basin will sheet flow across the rooftop and collected by localized area drains and conveyed to design point 10.

BASIN C2 (Q5=1.0 cfs, Q100=1.9 cfs)

Basin C2 is approximately 0.26 acres consisting atop the proposed garage improvements and made up of a dog park with a turf and drainage system. Due to runoff contaminants within this basin, runoff will be collected within the turf drainage system and conveyed through an internal building system to the sanitary sewer.

The following basins are conveyed off-site and collected by existing off-site storm sewer infrastructure.

BASIN D1 (Q5=0.2 cfs, Q100=0.5 cfs)

Basin D1 is approximately 0.10 acres consisting of hardscape and landscape improvements. Developed runoff from the basin will sheet flow across these improvements and ultimately into Park Meadows Drive at design point 1A.

BASIN D2 (Q5=0.1 cfs, Q100=0.2 cfs)

Basin D2 is approximately 0.03 acres consisting of hardscape and landscape improvements as well as a portion of the proposed Site's entry drive. Developed runoff from the basin will sheet flow across these improvements into Park Meadows Drive where it will be conveyed via curb and gutter south at design point 2A. Runoff from this basin will be collected by an existing storm sewer inlet located at the south west corner of the proposed Site then routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN D3 (Q5=0.1 cfs, Q100=0.4 cfs)

Basin D3 is approximately 0.07 acres consisting of hardscape and landscape improvements. Developed runoff from the basin will sheet flow across these improvements and ultimately into Park Meadows Drive where it will be conveyed via curb and gutter south to design point 2A. Runoff from this basin will be collected by an existing storm sewer inlet located at the south west corner of the proposed Site then routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN D4 (Q5=0.1 cfs, Q100=0.8 cfs)

Basin D2 is approximately 0.17 acres consisting of hardscape and landscape improvements. Developed runoff from the basin will sheet flow across these improvements and down Station Street where it will be conveyed via curb and gutter east to design point 3A. Runoff will then be routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN D5 (Q5=0.05 cfs, Q100=0.1 cfs)

Basin D5 is approximately .01 acres consisting of hardscape improvements. Developed runoff from the basin will sheet flow across these improvements and down Station Street where it will be conveyed via curb and gutter east to design point 3A. Runoff will then be routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN D6 (Q5=0.1 cfs, Q100=0.5 cfs)

Basin D6 is approximately 0.08 acres consisting of hardscape and landscape improvements. Developed runoff from the basin will sheet flow across these improvements and down the service drive located north of the site where it will be conveyed via curb and gutter east to design point 9. Runoff will then be routed to the existing storm sewer inlets located at design point 9.

BASIN O1 (Q5=0.01 cfs, Q100=0.1 cfs)

Basin O1 is approximately 0.03 acres consisting of landscape improvements. Developed runoff from the basin will sheet flow across these improvements and ultimately into Park Meadows Drive to design point 1A.

BASIN O2 (Q5=0.04 cfs, Q100=0.2 cfs)

Basin O2 is approximately 0.04 acres consisting of landscape improvements. Developed runoff from the basin will sheet flow across these improvements and ultimately into Park Meadows Drive where it will be conveyed via curb and gutter south to design point 2A. Runoff from this basin will be collected by an existing

storm sewer inlet located at the south west corner of the proposed Site then routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN O3 (Q5=0.03 cfs, Q100=0.6 cfs)

Basin O3 is approximately 0.14 acres consisting of hardscape and landscape improvements. Developed runoff from the basin will sheet flow across these improvements and down Station Street where it will be conveyed via curb and gutter east to design point 3A. Runoff will then be routed to the basin located within the Station Street/RTD bus loop detention basin.

BASIN O4 (Q5=0.05 cfs, Q100=0.1 cfs)

Basin O4 is approximately 0.01 acres consisting of hardscape improvements. Developed runoff from the basin will sheet flow across these improvements and conveyed via curb and gutter east to the existing storm sewer inlets located at design point 9.

C. DRAINAGE DESIGN CRITERIA

A. REGULATIONS

The *Douglas County Storm Drainage Design and Technical Criteria Manual* (DC Manual) amended July 8, 2008, and the Mile High Flood District (MHFD) *Urban Storm Drainage* (MHFD Manual) (Updated: Vol. 1-Mar. 2017; Vol. 2-Sept. 2017; Vol. 3-Apr. 2018). These documents shall be referred to as the “Manual”.

B. DRAINAGE STUDIES, MASTER PLANS, and SITE CONSTRAINTS

The following Drainage Reports involving the project site were considered in this study:

1. *Lincoln Station Phase III Drainage Report* prepared by Calibre Engineering, dated January 2007.
2. *Lincoln Station Phase II and Phase III Drainage Conformance Letter* prepared by Calibre Engineering, dated March 14, 2008.

C. HYDROLOGIC CRITERIA

Five-year and 100-year storm event runoff was calculated using the Rational method. Percent imperviousness values are from Table 6-3 of the *MHFD Manual*.

Runoff coefficients are from Table 6-4 of the *MHFD Manual* using hydrologic soil group C. Times of concentration were based on land use imperviousness values as well as distance and slope of runoff travel. Runoff conveyance coefficients were determined using Table 6-2 from the *Criteria*.

Rainfall intensities (I) for the area are approximated by the equation:

$$I = \frac{28.5P_1}{(10 + T_c)^{0.786}}$$

P_1 represents the 1-hour design rainfall values in inches per table 6-1 Zone 1 of the *DC Manual*. T_c represents the time of concentration in minutes and consists of overland flow time plus travel time. Time of concentration is calculated as the sum of the overland flow time and travel time. Overland flow time is calculated over a maximum 300 foot distance using the FAA equation:

$$T_c = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_0^{0.33}}$$

- C_5 = basin composite runoff coefficient for the five-year storm event
- L = length of overland flow in feet
- S = slope of flow path in percent
- T_i = travel time in minutes

Travel time is calculated as the flow time through a length of street gutter or channel by multiplying the average flow velocity by the travel length. The minimum time of concentration used for urbanized basins was 5 minutes.

All hydrological calculations, including a summary of the 5-year and 100-year storm event flows, are provided in Appendix B. Sub-basin maps are also included in Appendix D.

D. HYDRAULIC CRITERIA

Hydraulic calculations in compliance with the Manual for street capacity, inlet calculations, pipe sizes, etc. will be included as part of the Phase III drainage report. Bentley StormCAD will be used to analyze the hydraulic grade line of the stormwater conveyances. The Urban Drainage Inlet Sizing spreadsheet will be used to size proposed site inlets, as well as analyze existing street flow capacity and existing inlet capacity.

E. WATER QUALITY ENHANCEMENT

Per the *Lincoln Station Phase III Drainage Report* due to the density of the development, water quality cannot be provided for the entire site above ground. Per County and Cherry Creek Basin Authority criteria, water quality must be provided for no less than 80% of the site. Water quality shall be provided above ground, where possible, by porous landscape detention basins, grass swales and sand filter basins.

There is an existing above ground sand filter basin designed for the Site's Water Quality Capture Volume (WQCV). In addition, there is an in-line underground storage vault design to accommodate the Site's 100-year storm event runoff detention. An anticipated imperviousness of 95% was assumed for the Site. The proposed imperviousness for the Site will be 82%, therefore, detention and water quality treatment for the Site is accounted for within the existing sand filter basin and underground storage vault.

D. STORMWATER MANAGEMENT FACILITY DESIGN

A. STORMWATER CONVEYANCE FACILITIES

The proposed development developed runoff will generally be collected by private storm sewer infrastructure, some will be routed to existing storm sewer infrastructure. 87% of the Site's developed runoff will be collected and conveyed to the existing sand filter basin where it will receive water quality treatment and then routed to an existing underground detention vault. Small portions of the Site's developed runoff will be released directly off-site and conveyed to nearby existing storm sewer infrastructure. Basins D4 and O3 will be conveyed off-site and routed to the detention basin within the Station Street/RTD Loop and merge with the on-site flows at the entrance of the I-25 culvert. Basins D2-3, D5, and O2 will be conveyed to existing storm sewer infrastructure and routed to the existing sand filter basin, merging with the on-site runoff. Basin D1 and O1 will be routed by Park Meadows Drive curb & gutter to the nearest existing storm sewer infrastructure. Calculations will be provided within the final Phase III Drainage Report confirming the conformance of the developed Site runoff with the existing storm infrastructure per the *Lincoln Station Phase III Drainage Report*, as well as zero negative impacts of on-site runoff conveyed off-site to the locations as described above.

B. STORMWATER STORAGE FACILITIES

The majority of on-site developed runoff will be routed to the existing sand filter basin and underground detention vault where it will receive water quality treatment and 100-year detention. The sand filter basin is located north east of the existing parking garage and Site. The underground detention vault is located under the parking lot west of the office building directly north of the Station Street/RTD Loop. Per the *Lincoln Station Phase III Drainage Report*, the underground detention vault was designed for the 10-year and 100-year design storm events with 1.26 ac-ft and 1.85 ac-ft, respectively. The 10-year and 100-year storage volumes are controlled by their associated orifice's located within the underground detention vault. The vault also contains a micropool built into the base of the vault. There are no new on-site water quality or detention facilities anticipated. Calculations will be provided within the Phase III Drainage Report confirming the conformance of the developed Site runoff with the existing storm infrastructure per the final *Lincoln Station Phase III Drainage Report*, as well as zero negative impacts of on-site runoff conveyed off-site to the locations as described above.

C. WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

The majority of on-site developed runoff will be routed to the existing sand filter basin and underground detention vault where it will receive water quality treatment and 100-year detention. The Site will convey the majority of the Site's developed runoff, 91%, to the sand filter basin where permanent water quality treatment is provided. Temporary erosion control measures will be installed during construction to mitigate sediment leaving the site.

D. FLOODPLAIN MODIFICATIONS

It is not anticipated that any floodplain modifications will be required as a result of the development of the proposed Site.

E. POTENTIAL PERMITTING REQUIREMENTS

Douglas County will require a Grading, Erosion, and Sediment Control (GESC) approved plan and permit prior to construction. In addition, a state stormwater discharge permit will be required.

F. GENERAL

All tables, figures, and charts discussed above comply with the *DC Manual* and *MHFD Manual*.

E. CONCLUSIONS

A. COMPLIANCE WITH STANDARDS

The proposed drainage concept complies with the current City of Lone Tree Drainage Criteria, as well as the *DC Manual*, *MHFD Manual*, and Drainage Studies previously mentioned within this report.

B. VARIANCES

No variances were necessary for this report.

C. DRAINAGE CONCEPT

Development of the proposed site will not adversely affect surrounding developments. A majority of the developed site runoff will be captured by proposed inlets. The proposed storm sewer infrastructure will convey developed site runoff to the existing sand filter basin and underground detention vault, where it will be treated and detained.

F. REFERENCES

1. *Lincoln Station Phase III Drainage Report* prepared by Calibre Engineering, dated January 2007.
2. *Lincoln Station Phase II and Phase III Drainage Conformance Letter* prepared by Calibre Engineering, dated March 14, 2008.
3. FEMA, *FIRM Panel Map No. 08035C0061H*, Revised February, 17 2017.
4. Urban Drainage and Flood Control District, *Urban Storm Drainage Criteria Manual*, Updated: Vol. 1-August 2018; Vol. 2-September 2017; Vol. 3-April 2018.
5. "Douglas County Storm Drainage Design and Technical Criteria Manual" amended July 8, 2008